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for the IBM Personal Computer

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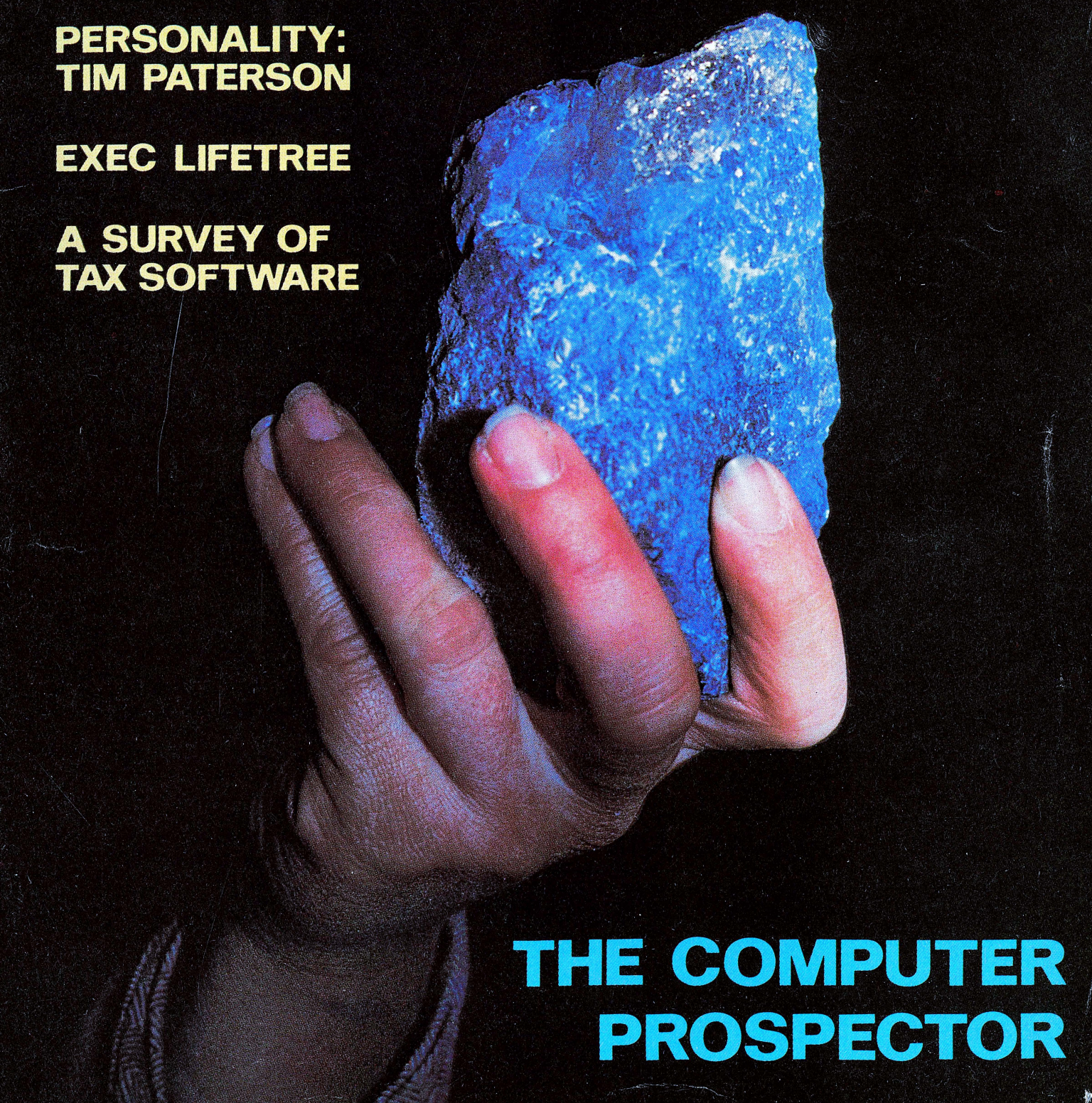

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Cover photo by Kurt A. Wahlner.

Composition by Photographics, Hollywood, California. Printing by Volkmuth Printers, Saint Cloud, Minnesota.

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Postmaster: Send address changes to Softalk/IBM, Box 60, North Hollywood, CA 91603.

Subscriptions: Complimentary trial subscription to all owners of IBM Personal Computers in the USA. If you own a pc, but you aren't receiving *Softalk for the IBM Personal Computer*, send your serial number and mailing address to Softalk/IBM Circulation, Box 60, North Hollywood, CA 91603. Non-pc-owner subscriptions: $24 per year. Back issues (from June, 1982): $3. *Softalk for the IBM Personal Computer* is totally independent of International Business Machines.

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THE FIRST OCCASIONAL IBM SOFTALK LILTIN' LIMERICK CONTEST

What's wrong?

You didn't even bother to enter the date and time the last time you were prompted.

Tired? Lazy? Overworked?

Admit it: that's why you're reading this, hoping we'll have the cure for your computer blahs. And, of course, we do: enter the March limerick contest! It's Saint Patty's birthday this month, and what better way to celebrate it than with some traditional Irish nonsense. You look like you could use some fun.

In case you've forgotten what a limerick is, the rhythm looks something like this:

And the rhyme scheme works something like this:

There was a young monk from Kuwait
Who said, "Although Mozart is great,
Plainsong is sweeter
It's simply completer
As background when we meditate."

Looks easy and fun, right? Well, it is. But just to make it more challenging, we've added the following rule: each limerick you write must incorporate the name of one of *Softalk*'s March advertisers or one of their products. The name needn't be the subject of the limerick; just work it in some way.

Any subject is okay, and your limerick can be funny, punny, witty, subtle, broad, cosmic, or ethnic—write what suits you. You may enter as many times as you like; each entry must be on a separate 8½-by-11 piece of paper attached to a separate entry form.

Limericks will be judged subjectively on such merits as wit, originality of rhyme, and the cleverness with which you've used the name of the advertiser or product. *Softalk* judges will pick ten semifinalists to be published in the May issue; the final winner will be chosen by you, the reader.

All entries must arrive at *Softalk* by April 5, 1983. Mail them to Rhyme Tyme, *Softalk IBM*, Box 60, North Hollywood, CA 91603.

First-place winner, chosen by readers of the May issue, will receive one hundred dollars' worth of products from one of *Softalk*'s advertisers. Semifinalists whose limericks appear in the May issue will receive ten dollars' credit each at their local retailers.

Have fun!

My limerick is attached. My local retailer is: _____
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Name: _____ Address: _____
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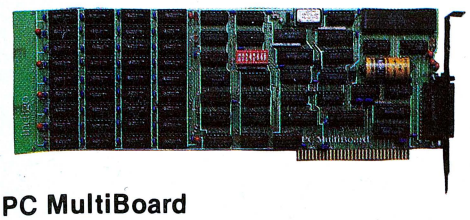

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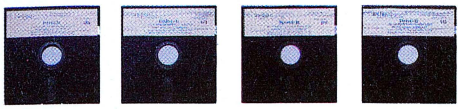

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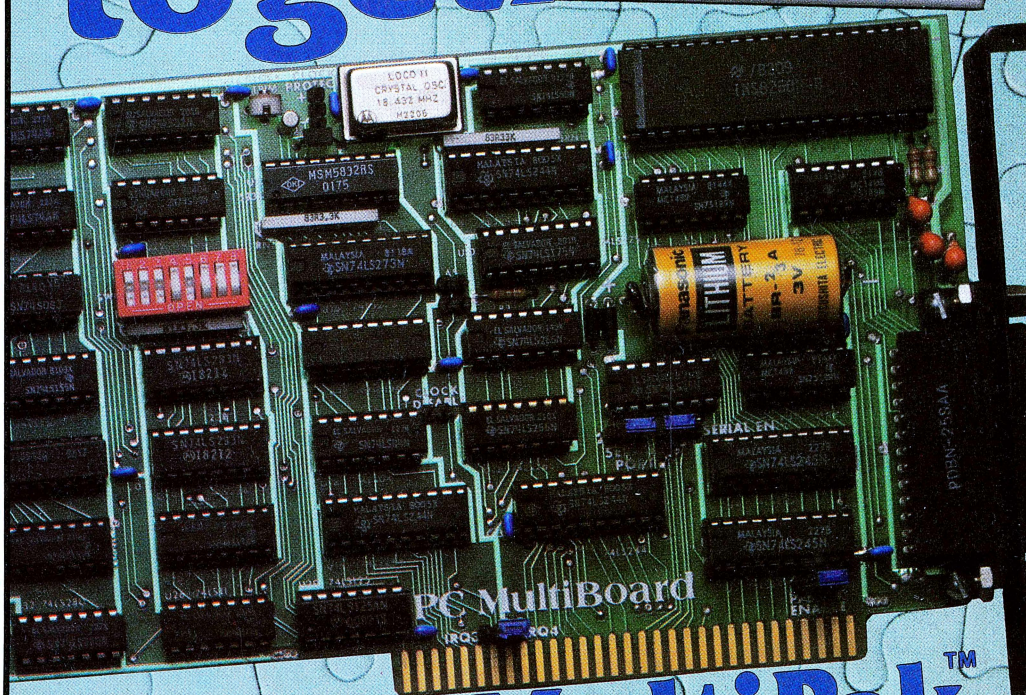

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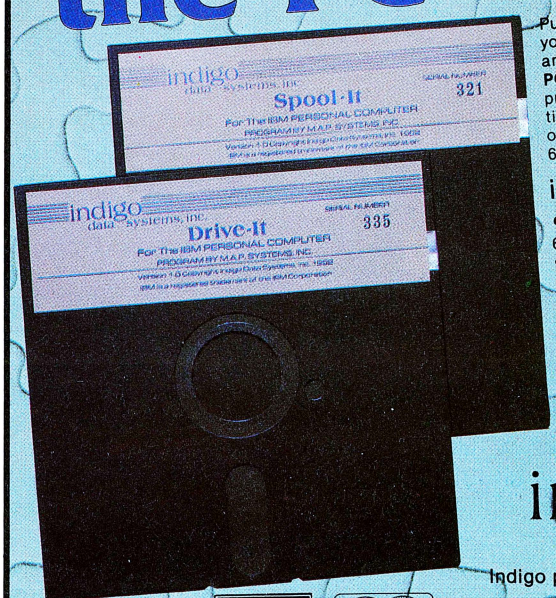

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Modula Mis-speak

Your February issue (p. 52) misstated some facts regarding our Modula-2 language system. The Modula-2 system is a complete development environment, which includes our Modula-2 compiler, Pascal compiler, comprehensive library, text editors, operating system, and a Unix-style shell program providing pipes and I/O redirection.

The price you stated is that of a software update, which is part of our continuing maintenance policy. It does not reflect the retail price of such an extensive software package. The correct retail price is five hundred ninety-five dollars.

Also, we have not yet announced Modula-2's availability on the IBM pc, but versions of the system are available on the Apple II, Apple III, Z-80/8080, TI990, and 68000-based systems, such as the Sage II. Complete system documentation is available separately for thirty-five dollars, and Wirth's new book, *Programming in Modula-2*, is available for sixteen dollars.

Roger T. Sumner, President,
Volition Systems, Del Mar, CA

WordStar Woes

I'm using *WordStar* on my pc with an NEC Spinwriter equipped with a multilingual thimble, and I'm unable to get the additional characters, beyond the standard ninety-four on the keyboard, to print. I got my system only a couple of months ago, so I'm a novice at this business. But I've already found out that I know more than the dealer, and an inquiry that I sent to NEC netted me a telephone call from a fellow who said he'd send me an "allocation chart" for the thimble I was using, but he didn't have any idea how it worked with *WordStar*. So much for support from them.

Then I tried the *WordStar* people. What I believed, judging from their literature, was that I could print accent marks by backspacing and then accessing the appropriate special character. What I want to do right now is print an umlaut over a, o, and u in German texts, but I'm reduced to using the double quotation marks because I can't figure out how to get the umlaut on my thimble to print. This works, but it doesn't look very attractive. However, MicroPro hasn't answered me yet. I'm beginning to think I'm getting the runaround.

I did get the "allocation chart" for my Elite 12/Multilingual A thimble from NEC, but it's just a bunch of numbers. I'd like to say that it's all Greek to me, but I can understand Greek. What I can't understand is what is written in the NEC manual. It assumes that the reader has "a basic understanding of data communications, interface protocols, and ASCII codes," and then proceeds to spit out all this technical jargon based on that incorrect (at least in my case) assumption. If I could just find out what an SO/SI is, I might have some hope of accomplishing my goal.

I think I'm capable of mastering some difficult concepts, but these people should start at the beginning. Perhaps some fellow readers could recommend some books for home study. *Softalk* would do well to publish some extended book reviews that would assist readers in selecting helpful literature. I, for one, need something more sophisticated than *A Child's Guide to the Computer*, something that does not assume I have had unlimited experience and understand all the jargon.

James L. Schaaf, Columbus, OH

Contesting the Issue

You are right—Apple users are wrong! Those of us that use the IBM do enter contests. At least this person does. We may not win, but we love to enter. I'm enclosing a photocopy of your entry form—one thing we don't do is cut up our issues of *Softalk*.

I researched, read, took classes, went to dealers, and it took a year before I decided to buy an IBM pc. No, that's not true. I decided I wanted an IBM the first second it was available, but there was no program that would do my job, and no dealer selling the pc in my area. I waited a year until both were available. I bought my computer needing to do one important job, and *VisiFile* was the only program that would do it without requiring much prior experience. Everyone else recommended *dBase*, but it cost twice as much, needed expensive customizing, and allowed only 1,000 characters in a form when I needed almost 2,000. I have been using *VisiFile* for two weeks since I got my computer and am very happy with it. It is doing what I had visualized it would do.

As a small business owner who basically purchased the computer to do one important job for my business, I'm not interested in using it for a lot of different jobs or buying a lot of programs for it. For one thing, I think most software programs are grossly overpriced. At one hundred dollars to two hundred fifty dollars per new application, they dollar you to death. If they were twenty-five dollars to fifty dollars each I might want to add some. But I don't want to end up spending more for software than I did for my computer. I would be very interested in reading an article that tells why software is priced so high. If there is a justification for it, I'd be interested in knowing what it is. I feel FriendlyWare has a more realistic pricing policy, and if its new pc *Arcade* package offers as much at the same price I might be interested in purchasing it. Other than that, I'm not interested in playing games on my computer when adding each one can cost me fifty dollars and up.

In the January '83 Boards & Buses, Richard Kaapke mentions the problem of the parallel printer adapter on a Quadboard having to inelegantly hang out the back if the computer does not have a breakout there. This is what happened to me on my IBM because the dealer said the newer models did not provide a breakout section any longer for some reason. I found that the first time I took the cover off my computer the printer cable was being pinched in a way I was not satisfied with. My seventeen-year-old son took one of the unused metal board covers from the back of the computer and custom cut the metal to the exact requirements for the size of a printer cable connection. Now my computer looks great and my cable is even protected inside.

Grace Johns, Pebble Beach, CA

Byte by Byte

To Alan Boyd: As usual, your System Notebook column in the January '83 issue of *Softalk for the IBM Personal Computer* was full of accurate and interesting information about the insides of the DOS. However, the significant point you made about the two time bytes being stored in reverse order is simply wrong, and the DOS manual appendix (page C-3) is correct. Let me explain it again.

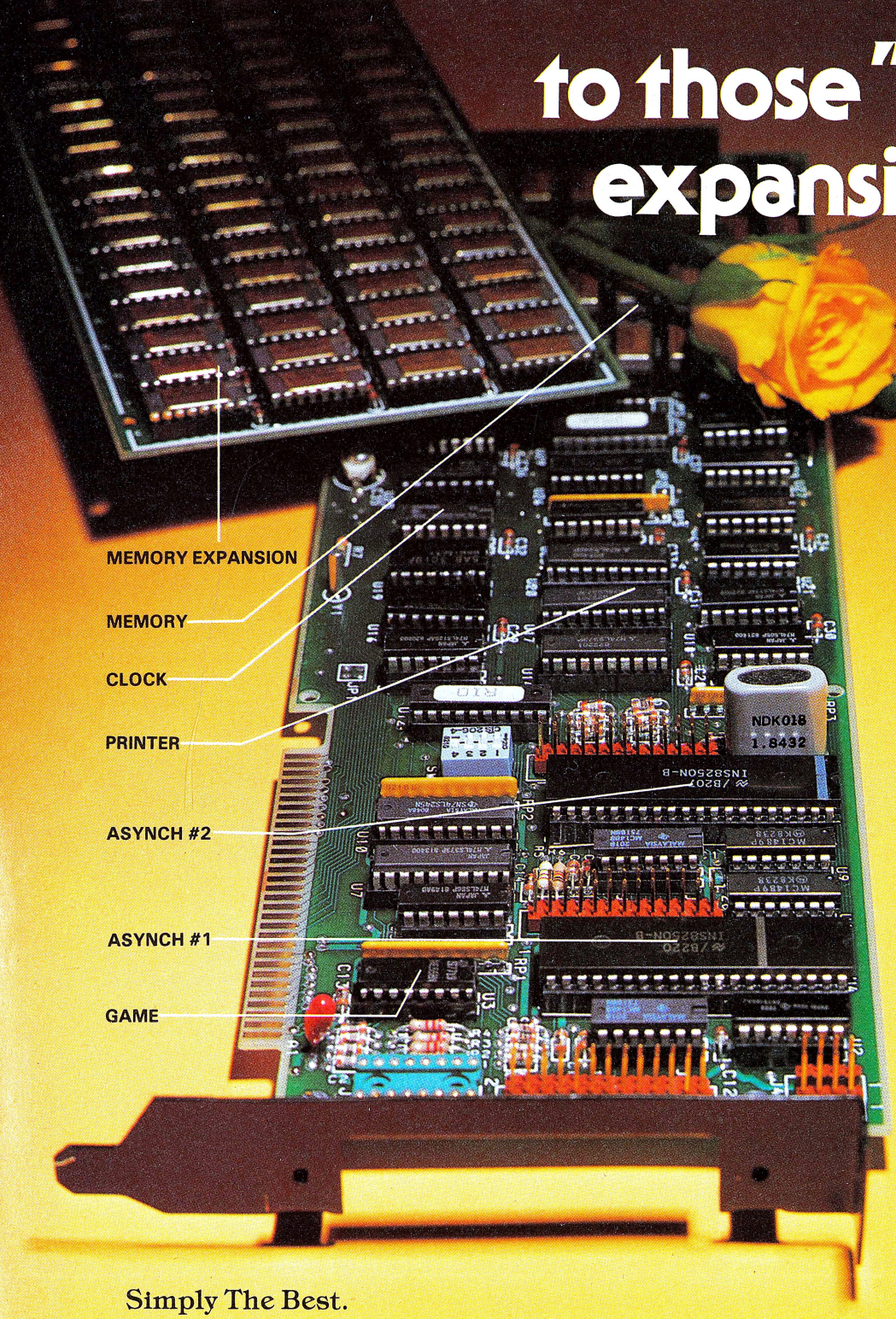
The lower-addressed byte of time contains the seconds and the least significant bits of the minutes. The high byte has the upper minute bits and the hours. This must be considered normal for the 8086, which always stores the least significant byte first.

The DOS appendix shows the time bytes referenced as a word. The bits are all correct, with bit 0 being the least significant bit of the seconds. If you increment the time as a word, you do indeed add two seconds to that time.

The date bytes and size bytes are also stored with the least significant byte first. The low byte of the date has the days and part of the month. The file size is a pure thir-

A fond farewell...

to those "Big Blue" expansion blues.



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ty-two-bit number, lowest eight bits first, with succeeding bytes being of greater significance.

By the way, the sole reason for packing date and time into two bytes is because of the tight space requirement of the File Control Block. This is the internal data structure used by programs to access files, and it includes date and time, among many other things.

Remember me? I wrote DOS.

Tim Paterson, director of engineering,
Seattle Computer, Seattle, WA

It appears that we did manage to cause even more confusion than existed before. Tim is absolutely correct. The confusion arises from the order in which the 8088 addresses a word in memory. A word is, of course, a 16-bit entity, and therefore straddles two bytes. The order in which the bits are arranged is therefore lined up in memory as

7 6 5 4 3 2 1 0
15 14 13 12 11 10 9 8

with 0 being the least significant bit. When the 8088 does an increment word, *it increases the least significant bit—which does indeed add two seconds to the time.*

Alan Boyd

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Personally Preventive

I like your magazine better than any other devoted to the IBM Personal Computer. Thus, I have mixed feelings about my first letter being a criticism. Your software poll, however, is a good idea poorly executed. It will not prove anything. As a Ph.D. psychologist with some training in the evaluation of research methods, I see several major flaws in your design. First, however, more about the good idea. You make an excellent point when you remind us that people buy software for reasons that may have nothing to do with its quality or its ability to work for them. The combination of powerful advertising, excited, eager new computer owners, and relatively uninformed computer store salespeople (who make higher commissions from one hardware system sale than from ten software sales) results in high-volume sales of poor-quality software.

Softalk's poll, however, is based on the false assumption that the way to find out what is really good is to poll users. You are close. The way to find the quality software for the IBM pc would be to study groups of average users working with various word processors, spreadsheets, or databases and see what happens. This is the bottom-line research model in every field of study. Your method will not accomplish anything like this. Most users are not going to try out ten different word processors to learn which would really work best for them. Readers who have only used *EasyWriter II* or *WordStar* will not be able to say how that program compares to other word processors. Unless they have found *EasyWriter* or *WordStar* absolutely useless, they'll include it in their lists of ten favorites. Almost any word processor is better than no word processor, which is the comparison users will be making if asked to judge the quality of the only word processor they have ever owned.

In addition, working against your quest for truth is a powerful psychological principle labeled "cognitive dissonance." Simply stated, people find it very unpleasant to have strong beliefs or expectations "disconfirmed." Few people would not experience unpleasant feelings at having to admit that their four-hundred-dollar software purchase was a mistake. Once they have invested money and time in a program they will be strongly motivated to like it. Despite the limitations of following the opinions of a single reviewer, that is a psychologically safer route to follow than to trust the results of a user poll.

There are no shortcuts to the kind of information you are seeking in your poll. Systematic investigation of people using different brands of word processors given to them to test drive is the best way to conduct useful, informative consumer research leading to effective consumer education. The Society for the Prevention of Cruelty to Users (SPCU) is a new, nonprofit organization dedicated to doing that kind of research. The focus is the human factor in software evaluation, that is, investigating what happens when typical users try out various software packages over an extended period of time. The second step is publishing the results of these studies in reports prepared by professional writers in plain, nontechnical English.

I would like to invite readers to join us in our efforts. Any psychologists using an IBM pc are of special interest as potential investigators. Any reader willing to supply a list of currently used software, and willing to complete a questionnaire about it, should also contact us. The critical factor for success will be the cooperation of software publishers. We don't have dues-paying members or any other source of income. We hope to publish the results of our studies as cheaply as possible. Thus, we cannot afford to purchase the software and hope to obtain free copies from the publishers. Any package accepted for study will be reported on in our first consumer software guide, which we hope to have ready for distribution this fall. Each report will provide a comprehensive description of what each software program does, and how it does it. Interested people are invited to contact me.

Charles Spezzano, SPCU,
6716B East Cedar Avenue,
Denver, CO 80224

Remedial Instructor

In Michael Ferris's evaluation of *The Instructor* by Individual Software he remarked that this software package was unsuitable for the home user. This observation is quite erroneous. A home user myself with no previous knowledge of computers or programming, I purchased *The Instructor* as a means of becoming better acquainted with the IBM pc and found, contrary to your comment, that this product serves as an excellent introduction to the pc. I think it would be of value to any computer neophyte.

In fact, *The Instructor* impressed me to the extent that I wrote the people at Individual Software to compliment them on their product. This product is geared to the novice. It would be unfortunate if an individual, after reading your review, elected to purchase an alternate software tutorial.

James D. Feeney, Cambridge,
Ontario, Canada ▲

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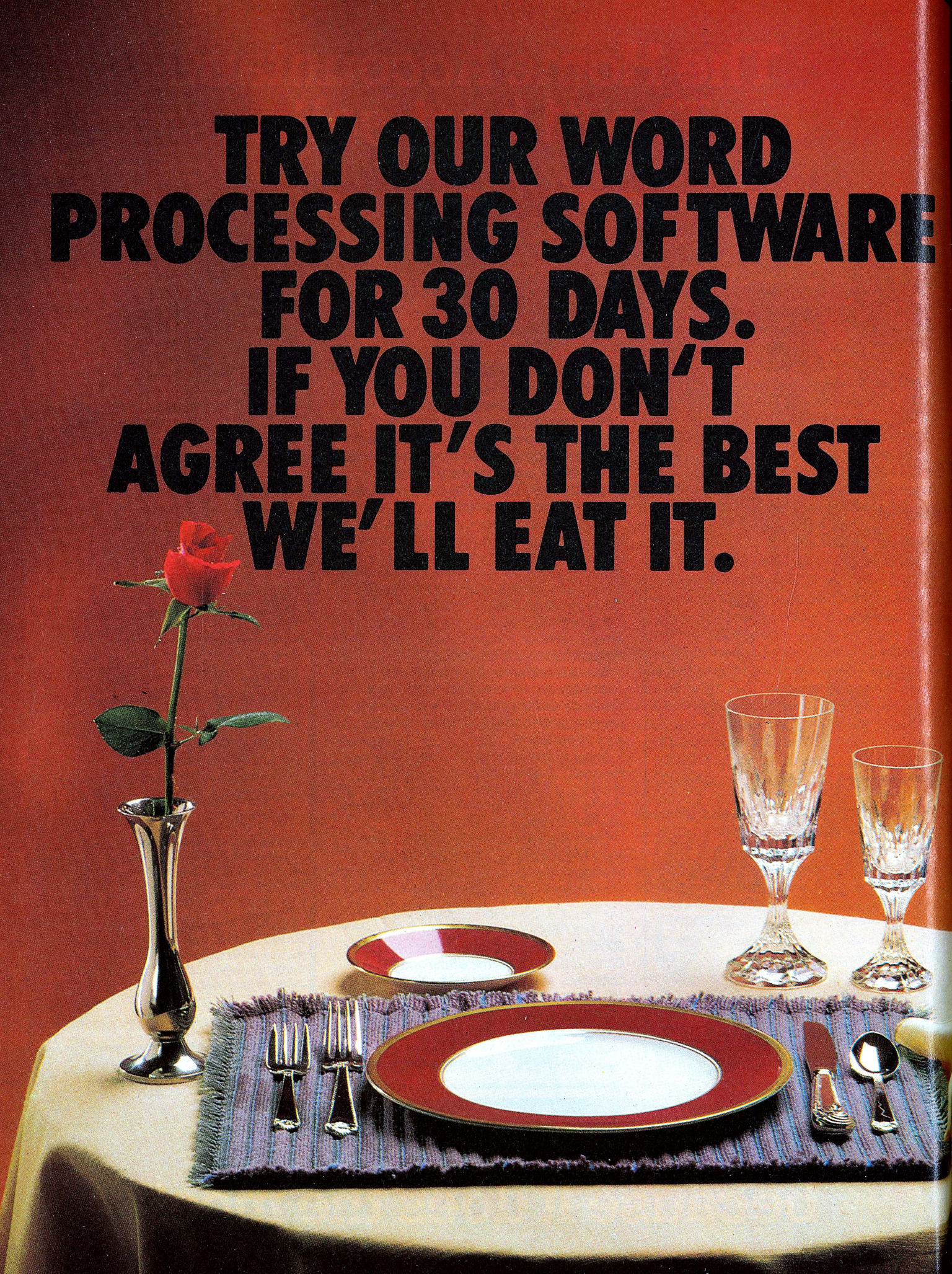

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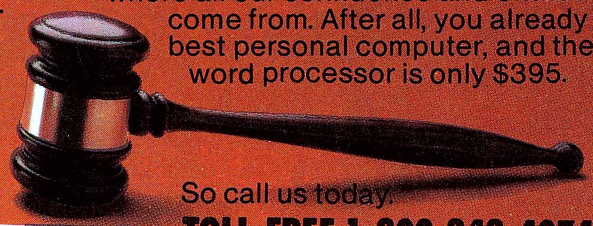

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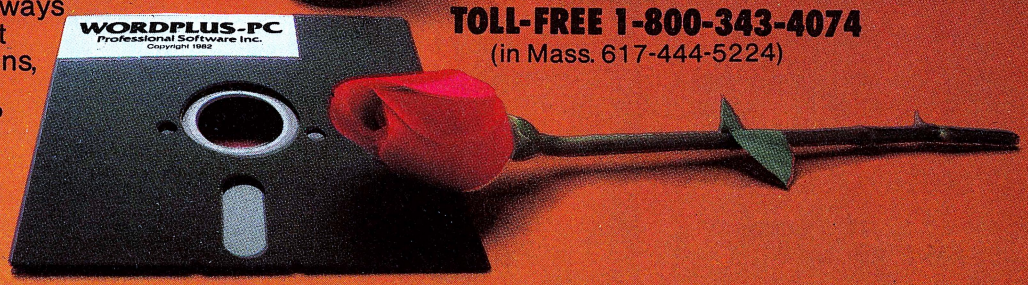

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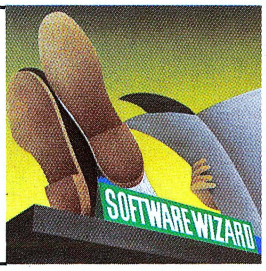

Δ **IBM** (Boca Raton, FL) has bought 12 percent of **Intel** (Santa Clara, CA), the pioneering semiconductor manufacturer. The $250 million from the sale of the stock will assure Intel the financial muscle to compete with corporations like Texas Instruments, Motorola, and especially against the Japanese, who now control 80 percent of the semiconductor market, according to *Fortune* magazine. Intel lost a large share of the market when its 64K chip initially flopped in 1981. The vote of confidence from IBM is expected to strengthen the whole United States computer industry.

Δ **VisiCorp** (San Jose, CA) has parted with its ad agency, **Regis McKenna** (Palo Alto, CA). Changing market conditions necessitated the move. VisiCorp, publisher of *VisiCalc*, has in the past contributed immeasurably to the success and growth of another Regis McKenna client, Apple Computer. With the introduction of VisiCorp's *VisiOn* and Apple's Lisa, the two companies became competitors. A spokesperson for Regis said the split was strictly a business decision. "It was a mutual parting; everybody understood the problems."

Δ **High Technology Software** has moved. Its new address: Box 60406, 1611 N.W. Twenty-third Street, Oklahoma City, OK 73106. New phone: 405-524-4359.

Δ Languages, operating systems, and graphics have been combined to form a Commercial Systems Division at **Digital Research** (Pacific Grove, CA). The new division is under the direction of Gordon Eubanks, Jr. Eubanks was formerly vice president of the Language Strategic Business Center. Digital's first formal division, the CSD restructures the company around the markets they serve rather than around the products they supply. As a result of the new organization, two of the three business centers are under new direction. **Allen Beebe** was promoted from director of engineering for languages to director of languages, replacing Eubanks. **Jackie Parakin** was promoted from director of engineering for operating systems to director of operating systems, replacing **Tom Rolander.** Rolander recently moved to the company's R&D division, headed by Gary Kildall, company founder and president. Fred Langhorst remains director of graphics.

Δ **Atel** (Burlingame, CA) has announced that **Rex Shotto** has joined the firm as director of software sales. Shotto was formerly a sales manager with Itel. In addition, **Rauf Ubaji** has accepted the position of manager of information systems with Atel. Before joining the company, Ubaji was an independent software consultant.

Δ **Lotus Development** (Cambridge, MA) has received an additional $3.7 million in venture capital, bringing its total outside funding to $4.7 million. Sevin Rosen Partners, Ltd., of Dallas and New York, and Kleiner, Perkins, Caufield, and Byers of San Francisco participated in both rounds of financing and were joined by Crown Associates of New York in the second round. The three firms specialize in high technology investments. "Lotus now has the resources to make a long and lasting impact on the personal computer software industry," says Mitchell Kapor, president of the company.

Vern Raburn, former vice president of Microsoft, and **Chris Morgan**, former editor-in-chief of *Byte* magazine and *Popular Computing*, recently joined Lotus. Raburn is executive vice president and general manager; Morgan is vice president of communications. Joining Kapor on the Lotus board of directors: **Benjamin Rosen**, a principal of Sevin Rosen Partners, Ltd., and **Alex d'Arbeloff,** president of Teradyne. Rosen is publisher of the *Rosen Electronics Letter*; d'Arbeloff is a well-known entrepreneur who built Teradyne into a leader in the automatic test equipment industry.

Δ **Intelligent Systems Corporation** (Norcross, GA) announces its plans to acquire the fifteen-month-old **Quadram** (Norcross, GA) for $35 million. The ten-year-old, publicly held ISC is a pioneer of computer-generated color graphics. "We are pleased to have an established manufacturing company working with us. We may even exceed their size within six months," says Tim Farris, president and cofounder of Quadram. The company will not become a division of ISC but will maintain its independent operating status.

Farris also announced that Quadram products will now be carried by both Macy's Computer Stores and Bamberger's stores, both now entering the retail computer business. "We expect this to signal the beginning of a trend," he says.

Quadram recently recruited **Otis Jones** from IBM as the company's new director of operations. Jones had been with IBM for sixteen years, most recently as program administrator in the national marketing division headquarters.

Δ **FriendlySoft** (Arlington, TX) has announced plans to introduce a "no-fine-print" lifetime guarantee that will cover all products developed and marketed by the company. One of the reasons for the guarantee, according to chairman and founder Michael D. Yaw, is to "offset any fears that may exist about copy-protected software." All products will be guaranteed for life, with forty-eight-hour replacement or repair available at no charge. According to the written guarantee, "mustard on the hub ring" of a disk is a qualification for replacement. In addition to the guarantee, a twenty-four-hour customer hot line will also be set up. ▲

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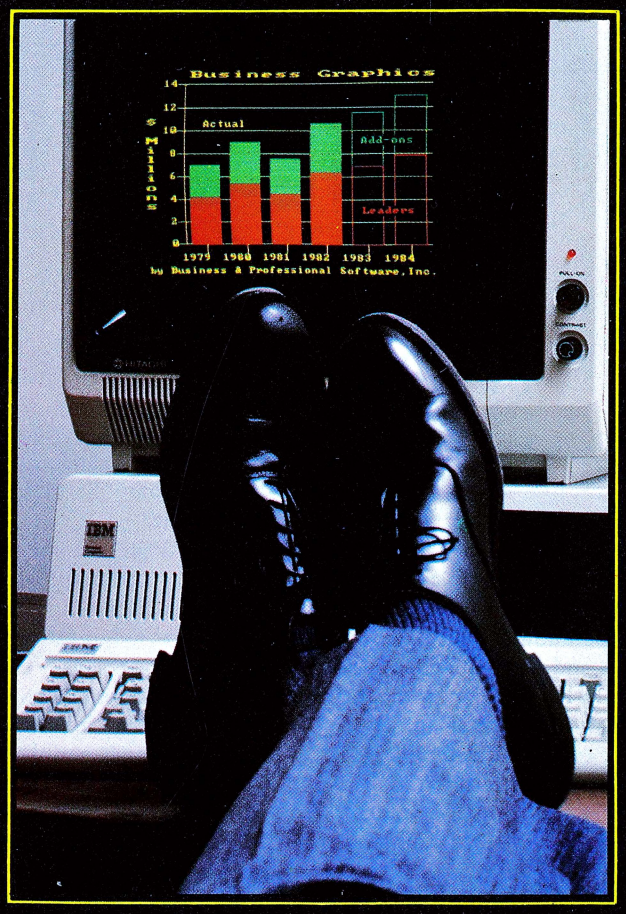

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TIM PATERSON
THE ROOTS OF DOS

by David Hunter

"Life begins with a disk drive."
—Tim Paterson

One does not write an operating system and fail to pick up a little wisdom in the process, particularly when that operating system becomes the property of Microsoft Corporation.

Tim Paterson, who has changed jobs and companies fairly often in the past few years, is satisfied with his position at present. He's at Seattle Computer, a company that made its name in the S-100 market and has since developed its own microcomputer—the Gazelle. It's been almost a year since he quit Microsoft. His experiences constructing an operating system that eventually would be central to IBM's Personal Computer and many other computers is quite a story.

Seen and Not Seen. Paterson looks good. He wears faded jeans. He has a dark beard and moustache, and he often breaks into a mischievous grin. A terrific programmer and hardware engineer, at twenty-six Paterson is typically innocent-looking.

He and his kind are the backbone of computer companies. There is no shortage of business people and production people in the computer industry. There are only a few terrific programmers. Everyone else is replaceable. Yet, in a big company, programmers are sometimes the least known, least appreciated employees.

"With all the code being written out there, who gets the credit? People like Bill Gates get it all and he hasn't written anything in years," says Paterson.

Paterson has been a pawn, a very valuable pawn, in a gigantic game of corporate chess. He has been moved around the board and asked to perform numerous tasks, some of which he'd like to forget. Like any good pawn, he's been relatively straightforward and dependable. But deep down, he's always wanted to be his own master, to call his own moves.

"My dad was an electrical engineer and when I went to school it was the first thing I tried," Paterson says.

In high school, Paterson took a semester of Fortran. He worked with a 7400, one of the TTL series of small logic chips. He didn't learn good textbook design from classes. "I learned it by reading and playing with it. I got a lot of exposure to electronics stuff at home."

It was as a student at Seattle's University of Washington that Paterson first encountered personal computers. In early 1976, his roommate bought an IMSAI 8080. "He provided the cash. I selected and maintained it," recalls Paterson. "It had a 4K memory board with the 8080 chip and no I/O devices. You could play a few stupid games like 'chase the bit,' which was entertaining for fifteen minutes at a time."

Days of Wire and Solder. Later that year, Paterson got a job as a technician at a Seattle-area retail computer store. There he was an eyewitness to those early days when the only way to own a microcomputer was to buy components and assemble it yourself. He's not kidding when he says, "Life begins with a disk drive."

With his university courses and practical experience in the retail store, Paterson learned quickly. He started toying around with designing his own peripheral boards.

"I got to know Rod Brock of Seattle Computer when he came into the store periodically. We were selling his boards. Eventually he asked me to consult for Seattle Computer.

"They were having problems with a 16K static memory board for the S-100," Paterson continues. "Rod Brock hired me in June 1978, at fifty dollars a day, to make the board work. I left the retail computer store at that time." After a few weeks of consulting, he was made a salaried employee of Seattle Computer.

In his computer science classes, Paterson had become interested in operating systems, as well as hardware and compilers. After receiving his bachelor of science degree in June '78, he attended graduate courses off and on for about another year. But he gradually lost interest. "I thought they were too oriented towards theory and not what I needed."

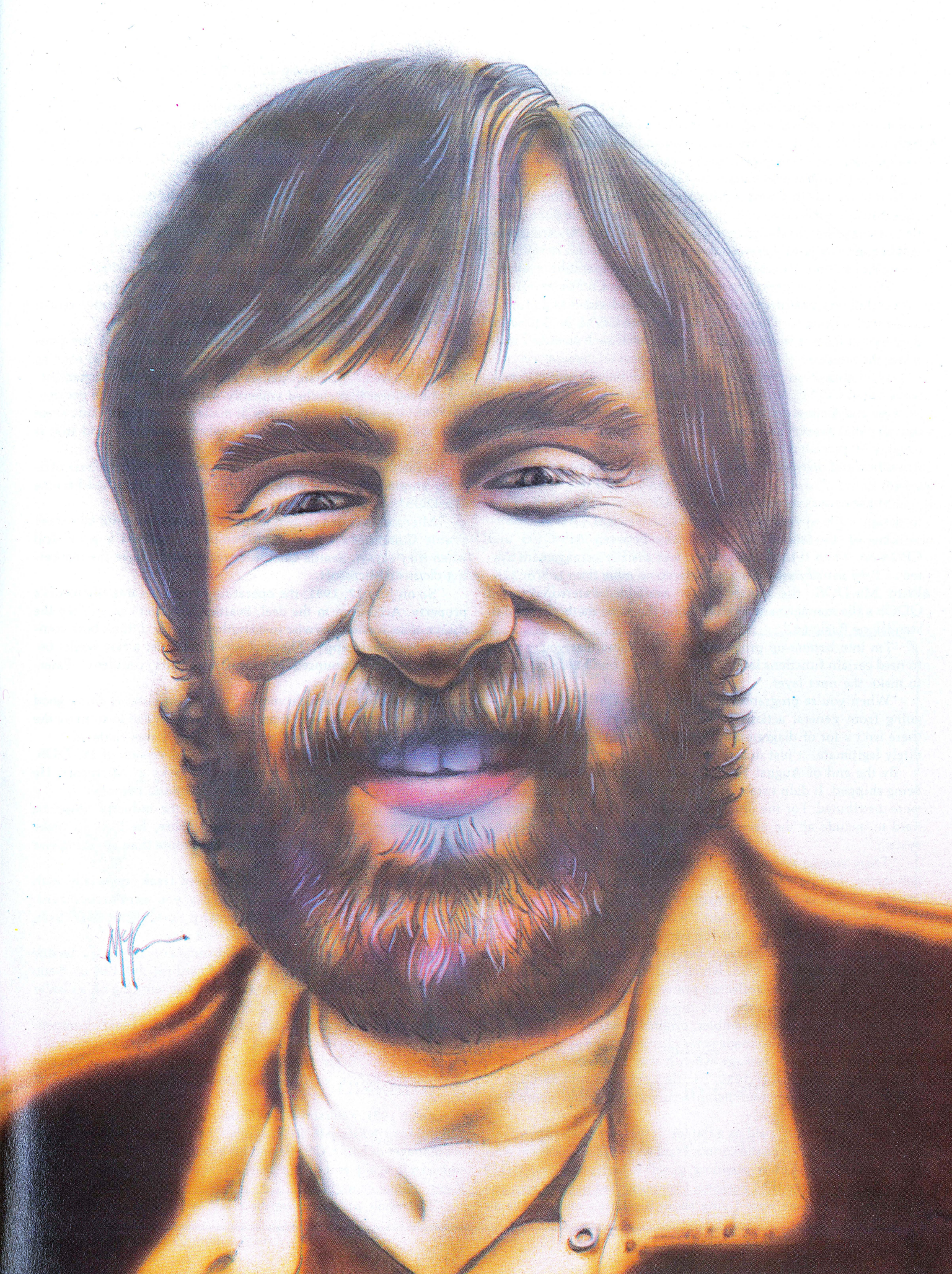
At Seattle Computer he at first worked on several projects—redesigning an S-100 memory board, which led to two new memory board designs. Things changed when he attended a local seminar on the Intel 8086 chip in late July 1978.

"I gained the respect of Rod Brock and made suggestions. I thought doing something with the 8086 would be neat and Brock gave it the go-ahead.

"The first design of the 8086 CPU card was finished by the end of January. We had a prototype by May 1979. We built three boards, but didn't wire them all up. There were both layout and design errors, but we got two prototypes working."

Rainy Day Computer. Seattle Computer was toying with the idea of eventually building its own computer, thus the CPU card project. They wanted to diversify, but had no firm business plan.

Once a prototype of the 8086 CPU was up and running, Seattle was approached by Digital Research to see if it could get CP/M to run on it. Microsoft, which had moved to the Seattle area in January 1979, wanted to see if some of its programs would work, too. At the end of May 1979, Paterson went to Microsoft to work with



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"That's pretty remarkable," says Paterson. "Microsoft already had developed several good utilities, like a cross-assembler for use with the PDP-10. There were a few bugs, but basically the CPU worked and the development tools worked."

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"I had always wanted to write my own operating system. I've always hated CP/M and thought I could do it a lot better."

Fast and Grimy. In the spring of 1980, Paterson started working on what would become MS-DOS. By July, he had finished roughly 50 percent of the operating system and called it QDOS 0.10 (for quick and dirty). He quickly found a bug and it became QDOS 0.11.

"Step one was to write down what CP/M-80 did. Step two was to design a file system that was fast and efficient."

One of the significant differences between MS-DOS and CP/M-86, when it finally appeared, was the file management system. CP/M usually provides a window to no more than 16K or 32K. With MS-DOS, the entire file is available. Paterson created QDOS's file management module using the same method found in standalone Basic-86.

"I'm into bottom-up programming. You know that you're going to need certain functions later in the program. I build tools on which to make the next layer.

"When you're programming top-down, it's stepwise refining—going from general actions to smaller actions. With my method there isn't a lot of diagramming. Bottom-up programming is definitely legitimate, it just doesn't get a lot of press."

By the end of August 1980, QDOS 0.11 worked well and was being shipped. It didn't stay QDOS very long, and not many copies were distributed. For the much improved update, Paterson worked hard to include all the necessary features of a complete operating system.

"There was an assembler, resident in the operating system, and debugging, but no editor. I wrote the quickest line editor I could imagine—quick in how fast I wrote it, two weeks.

"I was aghast," says Paterson, "when I heard that IBM was using it and not throwing it out the window."

Eighty-six on Cue. In December 1980, Paterson and company came out with 86-DOS, 0.33, which had significant improvements over QDOS. "86-DOS reflected pretty much everything we had learned so far. Just about the only thing it didn't have was variable sector record sizes. The assembler, originally written on the Z-80, was made faster. We also made some changes in the system calls. It was a pretty polished package when it was released."

Starting at the end of 1980, Seattle Computer sold 86-DOS to OEMs (original equipment manufacturers) and other companies like Microsoft.

"They [Microsoft] paid us a flat fee. It was not a per-copy royalty, but per OEM. Part of the contract said we couldn't ask them who they were selling it to or planning to sell it to."

In early 1981 the IBM Personal Computer had not yet been announced, but rumors were flying about Big Blue's micro. "We all had our suspicions that it was IBM that Microsoft was dealing with, but we didn't know for sure."

Around April 1981, while he was doing some internal changes on 86-DOS—modifying system calls and including error handling for hard disks—Paterson decided to quit Seattle Computer. In May, he went to Microsoft to work full-time on the PC-DOS version of 86-DOS.

"The first day on the job I walk through the door and 'Hey! It's IBM,' " says Paterson, grinning impishly. "I worked at Microsoft a neat eleven months. In May, June, and July I worked on things I hadn't quite finished, refining PC-DOS."

International Business Machinations. This was the beginning of an eleven-month hurricane. Almost daily, Paterson shipped stuff to Boca Raton for IBM's approval, and IBM would instantly return comments, modifications, and more problems.

"They were real thorough. I would send them a disk the same day via Delta Dash. IBM would be on the phone to me as soon as the disk arrived." Paterson pauses and winds up. He's remembering one request that clashed violently with his view of the project.

"IBM wanted CP/M prompts. It made me throw up." But when IBM asks, you comply if you're a lowly programmer, and that is what Paterson did.

He finished PC-DOS in July, one month before the pc was officially announced to the world. By this time, 86-DOS had become MS-DOS.

"Microsoft wanted to own it—pay all monies now and take it off Seattle Computer's hands. Both companies realized a good deal when they saw it. Seattle Computer really didn't have the marketing clout of Microsoft.

"So on July 27, 1981, the operating system became Microsoft's property. According to the deal, Seattle Computer can still see the source code, but is otherwise just another licensee. I think both companies were real happy. The deal was closed just a few weeks before the pc was announced. Microsoft was quite confident." Paterson pauses.

"Selling it was the right move. Seattle Computer is doing good without it. The timing was appropriate. I was invited to sit in on the meeting between Rod Brock and Paul Allen. I was flattered."

Is There Life after DOS? After the initial version of PC-DOS, Paterson went on to other programming tasks at Microsoft. He worked on an 8086 version of Microsoft's Basic compiler.

Paterson is like many programmers in the industry. Sure, he likes elegance. Sure, he likes simplicity. Sure, he likes to make things easy for the user. But what he likes more than anything else in a program or system is speed.

"I love assembly language. I'm a speed freak, especially with mathematical routines. If there's a loop that you want to repeat five times, I'll just rewrite the line that many times. Bam, bam, bam, woosh! The 8086 does normal loops real slow."

Paterson, still with Microsoft, did some consulting for Seattle Computer that fall, working on a RAM card for the IBM pc. Soon after he finished, he heard that Microsoft was working on a similar project.

"It was a real thrill to design a card for my employer's competitors. Microsoft was not too upset. They didn't chop my fingers off. By March 1982, Seattle's board had become quite popular. It came out months before anyone else came out with a multifunction board."

Late in 1981, Paterson and Microsoft got the word that IBM was looking for a 1.1 update. In November, he was made technical product manager of MS-DOS. He and his group delivered the initial version of 1.1 at the end of the year, a few days early. Then the Boca Raton deluge came.

"The whole process drove me crazy. A lot of bugs—PTRs [pro-

gram trouble reports]—kept dribbling in and IBM would make a phone call a day. It really drove me nuts. I felt like a puppet on an IBM string."

In March 1982, after two months of going back and forth with Paterson, IBM accepted 1.1. Paterson spent the last weeks of that month planning 2.0. Then, on April 1, he suddenly quit Microsoft. (Mark Zbikowski became the group manager and has brought MS-DOS to the brink of releasing the 2.0 version, which Paterson had little to do with.)

Not a man to burn his bridges, Paterson left Microsoft on good terms and returned to Seattle Computer to work, at first, on Seattle's floppy disk controller.

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"I have the urge to do another operating system—to see if, under the circumstances, I couldn't do it better. I don't think I will, though, not at Seattle Computer. I don't have the time.

"Currently, my job does not include designing software, though I consider myself a software designer. I can picture all kinds of neat things—combined packages. Memory's cheap these days and it should be possible to have a spreadsheet, word processor, database, and more at fingertip control in one package.

"Still, the 8086/8088 looks like it for a while. It'll go through a software jump; it hasn't caught up with the Z-80 yet."

Speed Racer. When far from the world of programming and corporate politics, Paterson is something of a race-car nut. He codrives a Mazda RX-2 in pro rallies.

"The car has a roll cage and we wear helmets and all that. I have an RX-7 and, yeah, I'm kinda into cars."

Paterson is still looking for that elusive something. Independently minded, he seeks complete freedom. He doesn't want to work for someone else all his life. More properly put, he doesn't want always to be doing someone else's work.

Some year Paterson would like to start his own company. When his Seattle Computer stock is worth enough, he just may sell it and go off on his own.

"Don't worry, the boss knows. Rod Brock said to me, 'Tim, in a few years you'll go.' There is the potential that I'll go all the way with Seattle, but I just don't know. Small companies that make it either become big or become part of a big company."

For the moment, Paterson is just another brilliant programmer. He's happy, but a little sad sometimes.

"Who cares who wrote the operating system?"

We'll remember, Tim. ▲

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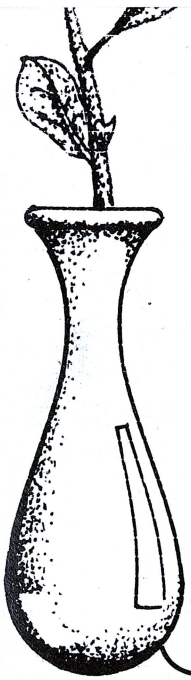

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"Step one was to write down what CP/M-80 did. Step two was to design a file system that was fast and efficient."

One of the significant differences between MS-DOS and CP/M-86, when it finally appeared, was the file management system. CP/M usually provides a window to no more than 16K or 32K. With MS-DOS, the entire file is available. Paterson created QDOS's file management module using the same method found in standalone Basic-86.

"I'm into bottom-up programming. You know that you're going to need certain functions later in the program. I build tools on which to make the next layer.

"When you're programming top-down, it's stepwise refining—going from general actions to smaller actions. With my method there isn't a lot of diagramming. Bottom-up programming is definitely legitimate, it just doesn't get a lot of press."

By the end of August 1980, QDOS 0.11 worked well and was being shipped. It didn't stay QDOS very long, and not many copies were distributed. For the much improved update, Paterson worked hard to include all the necessary features of a complete operating system.

"There was an assembler, resident in the operating system, and debugging, but no editor. I wrote the quickest line editor I could imagine—quick in how fast I wrote it, two weeks.

"I was aghast," says Paterson, "when I heard that IBM was using it and not throwing it out the window."

Eighty-six on Cue. In December 1980, Paterson and company came out with 86-DOS, 0.33, which had significant improvements over QDOS. "86-DOS reflected pretty much everything we had learned so far. Just about the only thing it didn't have was variable sector record sizes. The assembler, originally written on the Z-80, was made faster. We also made some changes in the system calls. It was a pretty polished package when it was released."

Starting at the end of 1980, Seattle Computer sold 86-DOS to OEMs (original equipment manufacturers) and other companies like Microsoft.

"They [Microsoft] paid us a flat fee. It was not a per-copy royalty, but per OEM. Part of the contract said we couldn't ask them who they were selling it to or planning to sell it to."

In early 1981 the IBM Personal Computer had not yet been announced, but rumors were flying about Big Blue's micro. "We all had our suspicions that it was IBM that Microsoft was dealing with, but we didn't know for sure."

Around April 1981, while he was doing some internal changes on 86-DOS—modifying system calls and including error handling for hard disks—Paterson decided to quit Seattle Computer. In May, he went to Microsoft to work full-time on the PC-DOS version of 86-DOS.

"The first day on the job I walk through the door and 'Hey! It's IBM,' " says Paterson, grinning impishly. "I worked at Microsoft a neat eleven months. In May, June, and July I worked on things I hadn't quite finished, refining PC-DOS."

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Paterson is like many programmers in the industry. Sure, he likes elegance. Sure, he likes simplicity. Sure, he likes to make things easy for the user. But what he likes more than anything else in a program or system is speed.

"I love assembly language. I'm a speed freak, especially with mathematical routines. If there's a loop that you want to repeat five times, I'll just rewrite the line that many times. Bam, bam, bam, woosh! The 8086 does normal loops real slow."

Paterson, still with Microsoft, did some consulting for Seattle Computer that fall, working on a RAM card for the IBM pc. Soon after he finished, he heard that Microsoft was working on a similar project.

"It was a real thrill to design a card for my employer's competitors. Microsoft was not too upset. They didn't chop my fingers off. By March 1982, Seattle's board had become quite popular. It came out months before anyone else came out with a multifunction board."

Late in 1981, Paterson and Microsoft got the word that IBM was looking for a 1.1 update. In November, he was made technical product manager of MS-DOS. He and his group delivered the initial version of 1.1 at the end of the year, a few days early. Then the Boca Raton deluge came.

"The whole process drove me crazy. A lot of bugs—PTRs [pro-

gram trouble reports]—kept dribbling in and IBM would make a phone call a day. It really drove me nuts. I felt like a puppet on an IBM string."

In March 1982, after two months of going back and forth with Paterson, IBM accepted 1.1. Paterson spent the last weeks of that month planning 2.0. Then, on April 1, he suddenly quit Microsoft. (Mark Zbikowski became the group manager and has brought MS-DOS to the brink of releasing the 2.0 version, which Paterson had little to do with.)

Not a man to burn his bridges, Paterson left Microsoft on good terms and returned to Seattle Computer to work, at first, on Seattle's floppy disk controller.

Wrong-Way Paterson. Seattle Computer was doing quite well. Paterson had owned 10 percent of the company since 1979, and had been an officer and member of the board. Achieving such a position at Microsoft was unlikely.

"It was not what was wrong with Microsoft, but what Seattle Computer had to offer. At Seattle, I'm director of engineering. Hey! That's really motivating. It was the basis for my moving back. I was a little irritated with Microsoft, mainly having to work with IBM. Microsoft recognizes talent. If somebody complains, they try to move them around."

Paterson moved himself, though, out the front door.

At present, he and Seattle Computer are "catching up." They have new S-100 products in the works and will have "new IBM stuff" soon.

"We're working on our expansion cards, making them with four functions instead of just two. We want to catch up with those four-function guys. We're also working on a new enclosure for the Gazelle.

"I have the urge to do another operating system—to see if, under the circumstances, I couldn't do it better. I don't think I will, though, not at Seattle Computer. I don't have the time.

"Currently, my job does not include designing software, though I consider myself a software designer. I can picture all kinds of neat things—combined packages. Memory's cheap these days and it should be possible to have a spreadsheet, word processor, database, and more at fingertip control in one package.

"Still, the 8086/8088 looks like it for a while. It'll go through a software jump; it hasn't caught up with the Z-80 yet."

Speed Racer. When far from the world of programming and corporate politics, Paterson is something of a race-car nut. He codrives a Mazda RX-2 in pro rallies.

"The car has a roll cage and we wear helmets and all that. I have an RX-7 and, yeah, I'm kinda into cars."

Paterson is still looking for that elusive something. Independently minded, he seeks complete freedom. He doesn't want to work for someone else all his life. More properly put, he doesn't want always to be doing someone else's work.

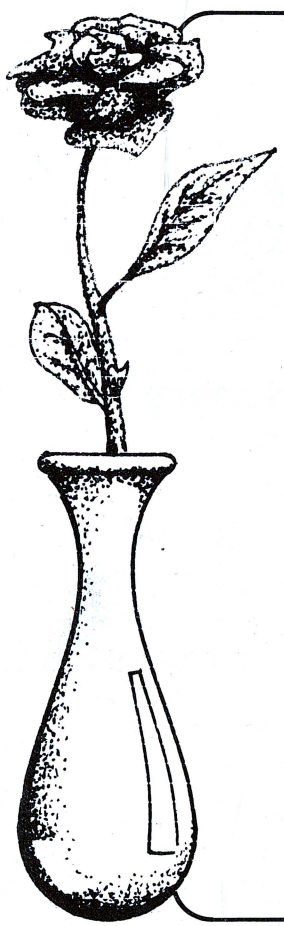
Some year Paterson would like to start his own company. When his Seattle Computer stock is worth enough, he just may sell it and go off on his own.

"Don't worry, the boss knows. Rod Brock said to me, 'Tim, in a few years you'll go.' There is the potential that I'll go all the way with Seattle, but I just don't know. Small companies that make it either become big or become part of a big company."

For the moment, Paterson is just another brilliant programmer. He's happy, but a little sad sometimes.

"Who cares who wrote the operating system?"

We'll remember, Tim. ▲



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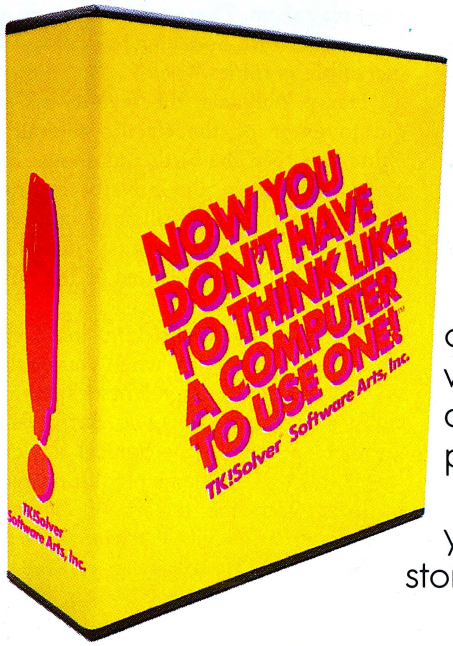

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Meeting people and machines makes the West Coast Computer Faire a mammoth microcomputer party.

PINBALL INDUSTRY SEES THE WRITING ON THE WALL

The pinball machine won't be around for you to tilt much longer. The celebrated pastime of hoods and punks is dying out in the arcades of America. The sounds of springing flippers kicking steel balls into alleys, banging them into bumpers, and zooming them around hairpin curves have been replaced by the explosions, tick-tick-ticks, and infectious tunes of video games.

Three years ago, more than two hundred thousand pinball machines were sold nationwide—an all-time record. But sales plunged to thirty-three thousand in 1982, prompting Stern Electronics, one of the big four manufacturers, to stop production.

Gary Stern, president of the company, says, "We have streamlined ourselves as a video company, concentrating on video games." *Berserk, Scramble, Cobra,* and the new *Bagman* are a few of Stern's electronic offerings.

Bally, Williams, and Gottlieb—the other three major manufacturers—have cut production sharply. "Pinball machines are expensive, labor-intensive games that are trouble for an operator. They're more prone to break down and don't earn as much as the video games," says Stern.

Today, video games dominate the marketplace, accounting for 87 percent of the $8.9 billion in commercial game sales last year, according to *Play Meter Magazine*, an industry publication.

"People today are taken with computers," says Stern. "It's even happening to me—and I was raised on pinball. I don't enjoy it as much anymore. When I go to a trade show I see pinball games and I don't even play them. There is just so much more you can do with a video game today—such incredible graphics."

Harry Williams, the seventy-six-year-old inventor of the electric pinball machine, has seen the birth and demise of the game. "We're in the novelty business," says the founder of Williams Manufacturing. "And novelty means one thing—sooner or later you get tired of the novelty of it."

Pinball was invented in the Depression era of the thirties, when you could get seven balls for a penny. The first commercially successful game was *Baffle Ball* by Gottlieb, a strictly mechanical device released in 1931. Williams revolutionized the business with the release of *Contact* in 1932, when he added electricity to the game for faster play. He sold twenty-three thousand of the games for $75 each. By 1935, more than eighty pinball manufacturers had entered the make-or-break pinball market, some lasting less than thirty days.

Many of the early games, like slot machines, paid off winners; others paid high scorers with free games. The cash

GOTO 20

FAIRE TIME!

Shine up your roller skates, lock up your plastic, and get ready for three days of computer madness. It's time for the Eighth West Coast Computer Faire in San Francisco.

Every size and shape of microcomputer, every kind of software, and every possible computer-related trinket and souvenir will be on display and for sale March 18-20 at Brooks Hall in San Francisco's Civic Auditorium. If you've never attended one of these gargantuan affairs, do not take the above warnings lightly.

The promoter, Computer Faire, in Woodside, California, is predicting attendance of anywhere from thirty thousand to fifty thousand. There'll be approximately seven hundred exhibitors; space reservations were filled by the middle of December.

Only three-day tickets are available; they're $15. The fair is so big, according to the promoters, that it's impossible to see the whole thing in one day. Unlike the recent Applefests, the West Coast Computer Faire will feature its usual well-rounded offering of conferences and presentations. The conferences will run all three days and overlap, so you'll have to be choosy.

The fair will be open from 9 a.m. till 6 p.m. all three days. Attendees can pay at the door, but may have to wait in line.

Last year's West Coast Computer Faire did not feature much for the IBM Personal Computer, but this year's show will be different. IBM has taken a very large exhibit space, and rumor has it that they may introduce a new, upgraded version of the pc, using the iAPX 186 or 188 microprocessors. These devices would improve the system's performance while reducing the integrated circuit count by about twenty.

Exhibitors sporting pc-compatible software ought to be in abundance, as well as the inevitable pc look-alikes.

Nevertheless, IBM Personal Computer owners in the Bay Area during the third week of March are advised to gorge themselves at this three-day microcomputer feast. You won't be sorry, though your feet may be sore come Sunday afternoon.

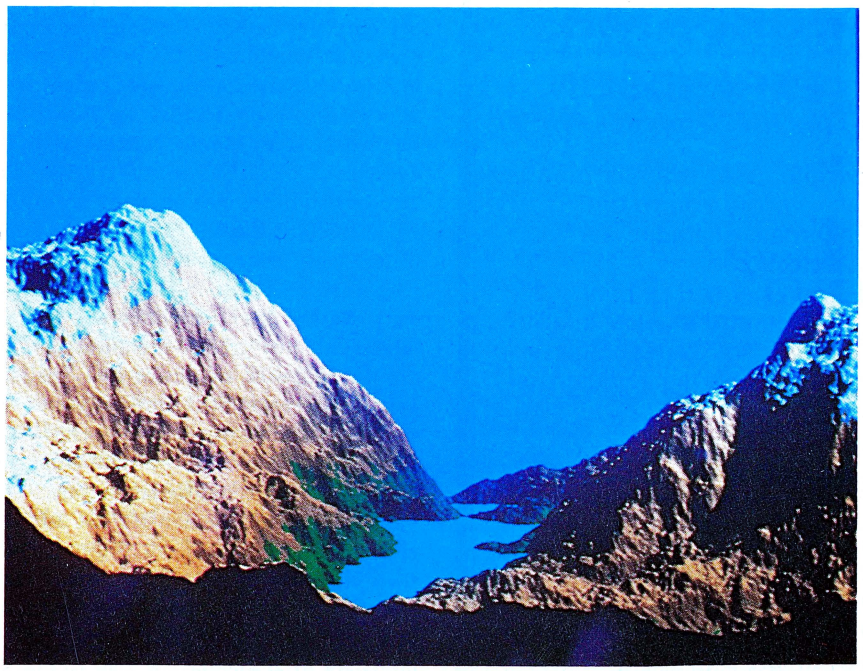
IBM Fellow Computes Fractal Geometry
Creates New Branch of Mathematics

A perfect circle does not occur in nature. Nor does a perfect square, a perfect triangle, or a perfect dodecahedron. The sloppy composition of the natural world has never had much of a place in the rarefied theoretical atmosphere of pure mathematics and computer science.

And yet, out of the seeming chaos of the randomly occurring shapes so much in vogue when the world was new, an order has now been wrought. Dr. Benoit Mandelbrot's *Fractal Geometry of Nature* (W.H. Pressman, San Francisco, 1982) takes sets of irregular or fragmented shapes and groups them into families, deriving mathematical theories therefrom.

Inside a mainframe computer, this means that randomly generated numbers can be made to correspond to the irregularities of a natural surface. Given this and a little color information, the computer fills in the details. The results, seen here, are pretty spectacular.

Mandelbrot, an IBM Fellow at the Thomas J. Watson Research Center in Yorktown Heights, New York, has used the computer to create a new branch of GOTO 20



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IBM Fellow

from page 19

mathematics. As he recalls, "Previously, natural shapes could be broken down into two categories: those one can tackle by the ordinary geometry of smooth shapes and those too complicated to be tackled geometrically. Between the two, I identified a new class of shapes that are complicated but whose complication is manageable. To everyone's surprise, many fractals have also turned out to be extremely beautiful."

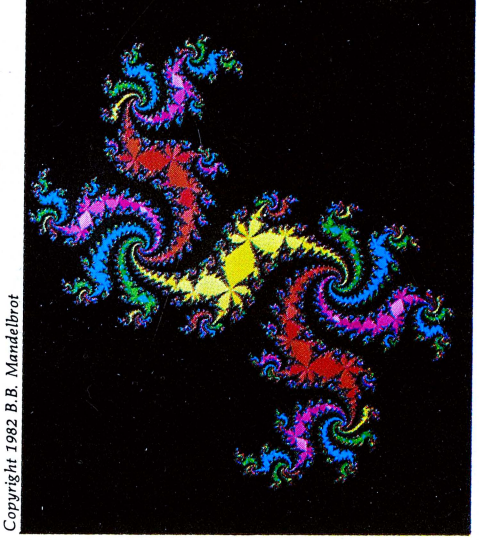
A fractal "dragon," if viewed on a computer with near-infinite resolution and magnified to a near-infinite degree, would not reveal greater simplification with enlargement, but greater complexity. These are the proposed shapes of non-Euclidean geometry—curves of infinite length or with infinite branching points—that were known as "monsters" by mathematicians because they are not demonstrable.

The graphic demonstration of fractals—showing beyond all argument that they do indeed exist—has greatly aided Mandelbrot and his associate at IBM, Dr. Richard Voss, in finding acceptance of the monsters in academia. He also found that the ability to actually see a fractal suggested modifications to his theories, and the whole process became interactive. "Every improvement in graphics ushered in a further step in the theory, and the merits of the theory led to much faster development of the graphics."

The new field is moving at least as fast as advances in the computer industry. "The book came out a few months ago, but was already out of date a year ago," says Mandelbrot, who also notes that the wide dissemination of his work probably had little to do with the elegance and sophistication of his equations.

"I was planning to just make a good picture of a mathematical theory, and to our surprise and great pleasure the illustrations were . . . aesthetically satisfactory. The publisher thinks that for each person who buys the book for the science, nine people are buying it for the pictures."

Mandelbrot is content in the knowledge that he has forced an esoteric branch of mathematics into the area of concrete, intuitive problems "that a child can understand but science could not tackle."



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Mandelbrot's fractal dragon, an aggregate of infinite curves.

PINBALL INDUSTRY

from page 18

payoffs are what linked the pinball industry to gambling and the mob, a connection they weren't able to shake for decades. Legend has it that in the early days of the game an executive of Murder Inc. was lashed to a pinball machine and dropped into a lake in the Catskills for attempting to cheat his partners out of pinball revenues.

The games' spreading underworld notoriety led New York Mayor Fiorello La Guardia to sledgehammer confiscated pinball machines in the late thirties. By 1942 they were banned in New York City; Los Angeles had already banned them in 1939.

It wasn't until thirty-five years later, in 1974, that the Los Angeles ban was lifted by a landmark decision of the California Supreme Court. Lawyers and representatives of the manufacturers played pinball in front of judges to prove they were games of skill and not chance.

The same year, Bally introduced the transistorized game with advanced circuitry that allowed digital scoring and futuristic sound effects. The Who and their rock opera (and subsequent movie) *Tommy* helped catapult pinball gaming to its greatest popularity in the middle to late seventies. Games got more complex, art got more risque, and the buzzers and bells got louder.

Also in 1974, the black-and-white video game *Pong* was introduced.

Pinball had by then survived the challenge of competing games, like air hockey and foosball, but the video revolution was the final blow, much to the surprise of the industry.

Space Invaders, *Asteroids*, and *Pac-Man* soon came crunching into the arcades like monsters. "It was very frightening to me," says Williams, who was working as a private consultant. "I knew we had to make superior games." But the game became old hat by 1981, ironically, only one year after the half-century-old industry's biggest sales year.

Software and Video Games Galore

80,000 ATTEND WINTER CES

We have seen the future and the future is the past.

If the Winter CES (Consumer Electronics Show), held this January in Las Vegas, had a message for the world of software, it was that to survive in big business one has to have a name—any name, as long as it has a past. It seemed as if every movie of any significance (and some of little or no significance) from the past twenty years is now a video game. And the licensing of movie titles seemed to be the order of the day at this show.

The sales pitch varied from innuendo to the time-honored technique of sensory overload. Parker Brothers showed clips from the James Bond film *On Her Majesty's Secret Service* and scenes from the upcoming *Star Wars* sequel *Return of the Jedi* as teasers for its new line of software for both video game machines and microcomputers. Visitors to the Parker booth didn't get to see much in the way of actual computer software, but the message was clear: Parker Brothers wants to penetrate the market via licensed movie titles converted into arcade games. Only time will tell if the games, none of which were available for play, can match the success of the movies upon which they are based.

On the other side of the movie license video game spectrum, seemingly far removed from Agent 007 and Luke Skywalker, were the forthcoming VCS horror movie games. Two titles in evidence were *The Texas Chainsaw Massacre* and *Halloween*, from Wizard Video Games. In each of these games, the player can be a psychopathic murderer chasing computer-controlled or player-controlled victims; or the player can be a victim pursued by another player or the computer. As promotion for the games, attendees were treated to some of the original films' bloodier moments on videotape. The games themselves were unfinished, but enough of the graphics were done to provide a taste of the mayhem to come.

But movie titles weren't the only things to emerge as possible video game spin-offs. Television characters, cartoon characters from TV and the daily newspapers, puppets, and rock groups were all in attendance as collections of pixels on the magic screen. The message was clear: big money has arrived in the software business. And the need to make one's presence felt has resulted in a near total loss of faith in the efficacy of original thinking. Sigh.

There were also some new kids on the microcomputer block, along with new toys from old hands in the neighborhood. Spectra Video unveiled a 32K RAM/32K ROM Z-80 based microcomputer geared toward the game player. Mattel unveiled its new Aquarius home computer, complete with a full line of peripherals. Mattel's booth, one of the largest at the show, was the focus of a good deal of curiosity; the company revealed new games for the Apple, Atari, and IBM Personal Computer. There was also a new version of Mattel's game machine—the Intellivision II—at half the size of the original with essentially the same features (an Intellivision III is rumored to be in the works). A new keyboard unit that connects to the Intellivision II was also shown.

Timex showed its latest offering, the Timex/Sinclair 2000, to selected buyers, while Texas Instruments showed off its new TI 99/2 micro. Atari also quietly displayed its latest microcomputer offering, the Atari 1200—a sleeker, more powerful version of the 800, complete with redesigned keyboard and peripherals.

Video technology was in abundance at the show, although few if any startling breakthroughs were in evidence. Videodiscs had a lot of support, with many new entertainment offerings released; and a surprising number of videodisc players were present. Showgoers walking from the Las Vegas Hilton to the main exhibit hall had to wend their way through a veritable forest of satellite dishes in the parking lot. Backyard-receiving-station prices have come down quite a way, and the result is that new companies and their wares popped up like so many mushrooms in the desert sun.

Unlike previous CES shows, this one had a number of microcomputer software companies in attendance. Old friends such as Broderbund, Datasoft, Synapse, and Epyx/Automated Simulations showed up to exhibit their products and talk to the buyers and mass merchandisers. DataMost used the show to announce a venture into the Atari market, the signing of new titles, and a merger with an East Coast firm. Sirius Software was also present with a whole slew of new titles.

The Winter CES show was one of the largest ever, with nearly eighty thousand attendees from all segments of the electronics world. The convention was so large this year that the show was held in three sites simultaneously. This meant that for

GOTO 23

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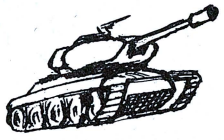

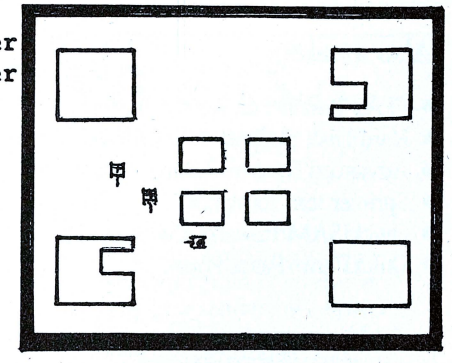

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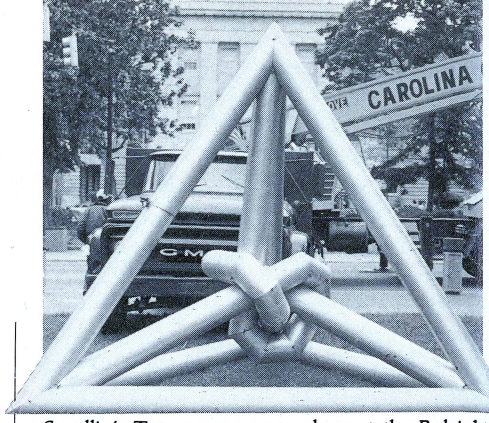
Sculptor Uses Computer To Design Works



Smullin's Tetragranny*—seen here at the Raleigh Arts Festival in Raleigh, North Carolina. The aluminum piece was designed with the help of computers at Duke University.*

Art was once a lot easier for Frank Smullin. At the end of his college years, he abandoned his plans for a career in biophysiology and became a sculptor. He started out in the sixties, firmly in the figurative, realistic school, but soon gravitated to abstract forms, usually networks of cylinders. The networks got bigger and more complex, and Frank decided it was time to employ the services of a computer.

As sculptor-in-residence at Duke University, he had access to an Amdahl mainframe and IBM 360 in the university's computations center. A student assistant would take an algorithm Smullin developed for a sculpture and write a Basic program. "I conceive of them as fat vectors" (a vector with a radius), says Smullin. "It's very easy to model mathematical networks of straight lines as the axes of the cylinders."

At least it was easy until his assistant graduated. Smullin then taught himself PL/1. Programming his own sculptures made him much more adventurous. "When I was asking a programmer to do these things for me I was always very reluctant to ask for subtle changes. I didn't realize you could just slip in there and substitute a line."

With his new programming freedom, the logistics of his sculptures grew in complexity, as did his program requirements. "I was working with alphanumeric data; I wasn't getting patterns or doing plotting," he explains. "My knowledge of the sculpture was entirely in terms of parameter fitting. I would ask the computer about the proximity of one part to another and it would tell me about parts in collision." The last work Smullin attempted "flying blind" in this fashion was *Labyrinth of Datalist*, constructed from a wire model, using the computer to juggle the data to make the parts fit and join the ends of the mitered cylinders snugly.

The experience was an arduous one, and it convinced him to explore the graphic possibilities of computer-aided design. In his initial foray into mainframe graphic software he utilized Tectronics plot-10 terminal control routines and a Calcomp plotter.

"I blew my year's budget in one month and went into hock to get a show ready," he recalls. Convinced of the fiscal impracticality of his situation, he commenced rewriting everything in Basic for the Tectronics 4052 in Duke's chemistry department. When he got the plot-10 routines working, *Labyrinth of Datalist* was the first sculpture he plotted out. To aid the eye in discerning which transparent-seeming pipes were going where, he shaded the final results by hand, because he had no hidden line routine. ("I used an armstrong routine with a colored pencil interface.")

Just as when he had learned how to program, the advent of the current generation of powerful microcomputers gave Smullin a new range of freedom and possibilities. Having begun work in the spring of 1982 on a CAD/CAM system that will run in a 32K environment, Smullin is now rewriting it to run on the Vectorgraphics Vector-4 terminal, taking advantage of that machine's raster screen and storage advantages over the Tectronics. For Smullin, micros meant "complete liberation. Free time is a wonderful thing. I didn't have to be concerned about every unsuccessful compile costing me ten dollars."

Gradually, computers have altered Frank Smullin's creative process. Initially, he had to make wire models and digitize the coordinates. Before he had graphic output, he had to work with geometrical concepts where it was impossible to keep the form clearly in mind. Today, it's possible for him to go in with the most general idea of what he wants to make and watch it materialize step by step, seeing the image continuously drawn on the screen and pressing the appropriate menu key to make a change.

"My goal is to create a system that allows me to manipulate a network of mitered cylinders with the plasticity of modeling in clay. Each time I want to make a new sculpture, I find I want to manipulate it in a way I haven't done before. When I was clay modeling or carving wood, I would often find I needed a different kind of tool, and I would go reforge a gouge or fit whatever I had to for whatever I wanted it to do. I'm always going back and reforging tools, and I find I do the same thing with the computer."

Multi-State Computer System Lights Up When Lightning Strikes

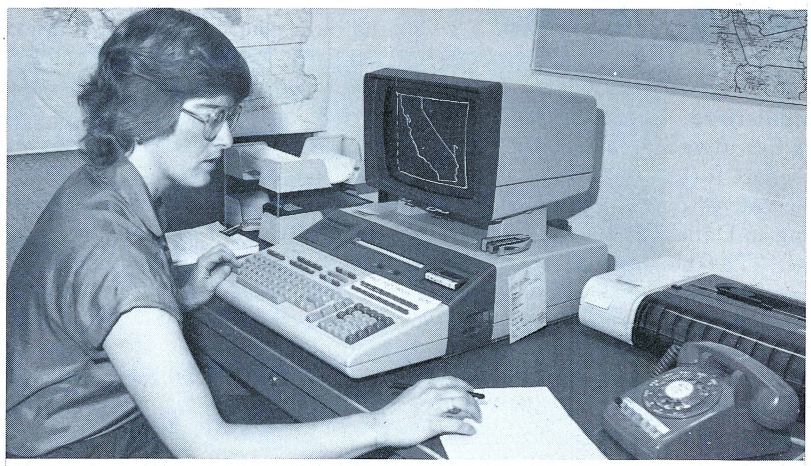
A computerized lightning detection system is playing a major role in reducing fire-fighting costs on federal lands.

When the Bureau of Land Management initiated its pilot program in 1977, the agency's fire suppression outlays stood at $24 million. Last year, they were hovering around $8 million.

Fifty-five percent of all bureau fires are started by bolts from the blue. The detection system, the brainchild of BLM's Denver office and the University of Arizona, pinpoints lightning strikes in the eleven western states and Alaska, giving firefighters the jump on potential trouble spots.

When lightning hits, electromagnetic sensors or direction finders relay the information to position analyzers, which plot the latitude and longitude of the strike. That signal is whisked to an Intel 8080 microprocessor in the bureau's western regional nerve center in Boise, Idaho, then back to a local BLM office and a Hewlett Packard 9845T minicomputer—all within a second.

A flashing "X" on an HP monitor display map marks the spot of the strike. During one six-hour period last year, more than seventeen hundred strikes in the Lake Tahoe region flashed on the monitor of lightning detection technician Marj Andreco. Andreco works out of BLM's Sacramento, California, office. By stroking a key, Andreco can get an instant printout of a map of California with Xs marking the lightning strikes. These are followed by listings of the time, latitude, and longitude of each strike. Andreco then sends helicopter and reconnaissance pilots to investigate.



Lightning detection technician Marj Andreco works on a Hewlett Packard minicomputer in the Bureau of Land Management's Sacramento, California, office.

The Automatic Lightning Detection System will eventually be merged with a Remote Automatic Weather Station, says Andreco. By combining weather reports with lightning strikes, fire investigators will be able to rank fire probabilities and conduct their air searches accordingly.

The bureau's overall system includes thirty lightning sensors, which have a two-hundred-mile range, and twelve position analyzers. Andreco pegs the cost of installing and maintaining the California component at around two hundred thousand dollars, but adds, "This system pays for itself many times over each year."

WINTER CES

from page 21

the first time, attendees could spend all three days at the show and never see all of it. Those wishing to concentrate on a single area of the market often didn't bother to travel from building to building, choosing instead to remain in the hall devoted to their particular area of interest.

All in all, software clearly held sway this year. Between the mad scramble for home-video-game market share and the attempts of large concerns to cash in on the microcomputer boom, the main exhibition hall was filled with the buzzes, squeaks, clicks, and roars of computer games.

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NEWS BITS

Δ **Computerized Head-Hunting.** Peat Marwick Executive Search has published a new brochure describing the challenges facing executives in today's marketplace. According to Donald F. Dvorak, partner-in-charge, "The brochure highlights the fastest-growing areas of recruiting—high technology, management information systems, health care, insurance, banking, and energy." Peat Marwick analyzes the needs of a customer and then searches for qualified candidates using a variety of methods, including Execscan—a national database of executive profiles and employment histories that is continually updated. Peat Marwick Executive Search is based in Chicago and is a consulting service of Peat, Marwick, Mitchell and Company, a large international accounting firm.

Δ **Meeting of Machines.** Two events slated for Chicago's McCormick Place this April 26-28, the Information Management Exposition and Conference for Manufacturing (INFO/Manufacturing) and the Exposition and Conference for Advanced Manufacturing Systems (HI-TECH/Advanced Manufacturing Systems), will focus on bridging the gap between executives who manage computerized systems and those concerned with advanced manufacturing technologies. The focus of INFO/Manufacturing will be on helping manufacturing companies extend existing computer systems and integrate them into a single system with information from the marketing, accounting, R&D, purchasing, and shipping departments. HI-TECH/Advanced Manufacturing Systems will concentrate on the use of robotics, computer-aided design, manufacturing and engineering, computer-controlled machine tools, flexible manufacturing systems, automatic assembly and equipment systems, automatic guided vehicles, programmable controllers, optical measuring systems, and laser technology.

Δ **Heavy Metal Computing.** Barber-Greene Company of Aurora, Illinois, has announced the formation of Barber-Greene Information Systems, Inc. This wholly owned subsidiary was established to provide complete business computer systems for the highway and heavy-construction industries. The turnkey systems will include hardware and software programs such as general accounting, estimating, preventive maintenance, job costing, scheduling, and other functions specifically written for the highway and heavy-construction industries. Particular emphasis is put on asphalt, ready-mix, and aggregate producers and contractors. Product development and testing is under way, and specific product announcements are planned for mid-1983.

Δ **Coleco Strikes Back.** Coleco Industries has joined forces with *Star Wars* special effects guru John Dykstra. Coleco and Dykstra's company, Apogee, Inc., will collaborate on the development of video games and personal computer software. Dykstra is best known for his contributions to *Star Wars* and the television show *Battlestar Galactica*, efforts for which he won an Academy Award and an Emmy. Dykstra has already produced five television commercials for the ColecoVision video game system, applying his much-touted special effects expertise.

Δ **From Professionals to Amateurs.** Qantel Business Computers, a Mohawk Data Sciences company, has announced Intercollegiate Sports-Pac, a complete athletics management system. Ten teams in the NFL already use Qantel's *Pro Sports-Pac*, and the same basic features are now being offered for colleges. The system runs on one of Qantel's minicomputers and includes applications for accounting, ticketing, administration, training, coaching, public relations, and recruiting. In 1982, Penn State became the first college to try the system.

Δ **How Much for That Little Android in the Window?** You'll hear a lot about personal robots this year; several are already available. Heath Corporation's Hero I has made the biggest splash so far. Controlled by an onboard computer, with light, sound, and motion sensors, and run on rechargeable batteries, Hero I is being touted as the "first sophisticated teaching robot." With optional voice and arm, Hero I resembles hobbyist robots built in the past in basic design, but is slicker on the outside. The complete assembled robot, with arm and voice, costs about twenty-five hundred dollars. ▲

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EXEC LIFETREE: THE VOLKS FOLKS

by Craig Stinson

How do you write a bestselling word processing program for the pc?

Clearly, what you do is spend six years in New York in the book-publishing business, add another three as a computer consultant for Wall Street financial firms, fall in love and follow the lady (or gentleman, as the case may be) from New York to California, get yourself a contract to write a book about a computer that doesn't already have a decent word processor, get so frustrated at the word processor that does already exist for this machine that you're forced to write your own just to keep sanity intact, then contrive for all other would-be word-processor makers to be late getting to market, and finally arrange for a major trade show to occur within a month after your program is up and running.

At any rate, that's the formula that Camilo Wilson followed in writing *Volkswriter*.

No Primroses. If that doesn't seem to you like the straight and narrow path to success, you're right, but it's probably less broad and tortuous than it appears. Wilson's career in the last year and a half is a case study in how success may be compounded from stance and circumstance—from talent, training, and character leavened with blind accident and plain good fortune.

Let's look at the circumstantial factors first.

Two years ago Wilson was doing well as a computer consultant in the financial district of New York. His clients included the likes of Chemical Bank, Blue Cross, and Merrill Lynch—folks who pay properly for computer expertise.

He packed it up one day and headed for the Coast, back to California. Not to escape the winter or the muggers or the other strains of big-city life. Quite the contrary—Wilson seems to have enjoyed those strains.

Camilo Wilson (seated, left) followed a trail of happy accidents to found Lifetree Software in 1981. The company has now outgrown its first suite of offices, in downtown Monterey, California. The new quarters (right), when finished, will give Wilson and colleagues a loftier view of Monterey Bay.

"I love New York," he says with convincing animation, "and I have the utmost respect for people who live there. It's such a tough place."

Rather, his move west was, he affirms without elaboration, "for personal reasons—romantic reasons."

When he reached the West Coast, Wilson noticed that the most exciting thing happening was microcomputers. He also saw that the party was already in pretty full swing.

"I was a little discouraged at first, because I couldn't see any good way to get into microcomputer software," Wilson admits. "The field seemed to be dominated by big companies like MicroPro and VisiCorp. But then in August [1981] IBM announced their machine, and I got terribly excited about the possibilities that presented."

The initial application of Wilson's excitement was not toward a software project but toward the fulfillment of a book contract.

"I was offered a contract to do one of the first books on the IBM Personal Computer," he remembers. "Ironically, I got the contract on the strength of a chapter I had written about how great it would be to have your own word processor on your own personal computer."

So the author-to-be paid his money upfront and camped on Computerland's doorstep. If a person was to write one of the first books on the pc, then obviously a person had to have one of the first pcs.

Next! Wilson came to the head of the queue in October and immediately set to work. The job was beset with frustration; there was virtually no technical information about the pc available at that time.

The biggest frustration, however, was that much-lambasted, much-derided word processing program IBM included in its initial release of the machine. Indeed, Wilson did not exactly earn the right to wear one of those T-shirts that some Silicon Valley smart aleck has recently put on the market ("I Survived EasyWriter 1.0"); he didn't survive *EasyWriter*—he found another mode of existence. More exactly, he created another mode of existence.

"After a couple weeks of trying to cope with *EasyWriter* and having files crash on me, I decided I'd better start by writing a quick-and-dirty word processor for my own use. About two weeks after that I said, 'Forget the book, let's just do the word processor.' "

There followed three grueling months of programming. "Underline the word grueling," Wilson urges. "There were some days when my old lady had to pick me up out of the chair and toss me in the shower. I couldn't have done it without her."

The fact that the IBM *Technical Reference* manual wasn't available for the first two months of *Volkswriter*'s gestation certainly augmented the programmer's challenge. Everything had to be figured out through experimentation. Just moving the cursor around on the screen was a matter of trial and error.

Nor was there an assembler. Microsoft's *Macro Assembler* wasn't finished yet (or, at any rate, had not been released by IBM),

Wilson demonstrates the international edition of Volkswriter. *No, Camilo, you have to hit "J" for "ja," not "Y" for "yes."*

and CP/M-86 for the pc, with its built-in Asm86, wasn't even close to market-readiness. Wilson, who in any case thinks the value of assembly language on machines as powerful as the pc is generally overrated, opted for IBM Pascal.

By February 1982 the early-model *Volkswriters* began rolling out of Wilson's Carmel Valley home. Lifetree Software was born.

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The timing could not have been better. "There was a window of about forty-five days there," Wilson recalls, "between the time when we had *Volkswriter* ready and the time MicroPro got *WordStar* on the market. For those forty-five days there was no other viable word processor available for the pc. We had no exposure to speak of, but we managed to get the program into about twenty stores, by going straight to the dealers and not through distributors. That cadre of twenty stores was enough to get us started."

Name Game. A little marketing expertise came in handy. Before his stint of consulting in New York, Wilson had spent six years doing marketing for the book division of the Arica Foundation, one of the more organized forces within the human-potential movement of the seventies. The programmer dug into his marketeer's trick bag and came up with a couple of very effective names.

The Lifetree moniker was a deliberate elision of Lifeboat and Peachtree—a variation on the old Goodyear-Goodrich ploy to stand in the reflected light of another firm's notoriety. "It was actually kind of a joke," Wilson recalls. "We couldn't think of anything else. And I didn't want to use one of those outlandish, stuffy names like Executive Software."

The same aversion to high-tech hauteur obviously motivated his choice of a product name.

"We went through the process of looking at all the names we could find. Most of them went for razzle-dazzle, so I said, 'Let's take a counter approach. Let's call it Plain Writer.' " Volkswriter, he allows, was a major inspiration.

The big boost for Lifetree Software came just a year ago, a month after the company's formation. Amid the noise and confusion of the West Coast Computer Faire, a few thousand frustrated pc owners stopped by the modest Lifetree booth and saw a quiet-spoken, articulate gentleman demonstrate his new word processor. No one seemed to care—or notice—that the gentleman was the entire company. Lifetree was rooted.

By making its first impression at the West Coast Computer Faire, Wilson and Lifetree fell in behind some distinguished predecessors. Apple Computer got its start at the Faire (1978); Adam Osborne's computer company took off from the same show in 1980. Other software biggies, like Sirius and Sierra On-Line in the Apple market, arrived at biggy-hood within a short time after their first exposure there.

Just Folks. The West Coast Computer Faire is that kind of event. Unlike Comdex and NCC, which tend to attract primarily the largest hardware and software companies and to appeal chiefly to dealers and other institutional buyers, the Computer Faire is a show for the common (if you'll pardon the expression) computer user.

And the common users—those who most needed and valued clear presentation, simplicity, and ease of learning and use—liked what they saw in Wilson's product. *Volkswriter* was probably the first pc word processor (other than Edlin, if you want to stretch the definition) that wasn't transplanted from some alien environment. It was written specifically for the IBM and, apart from three dot commands, it was driven entirely from the pc function keys.

It wasn't as powerful as *WordStar* and some of the other CP/M immigrants. But in March of 1981 those immigrants still resided in the Old World. And when the boats began to land later that spring and summer, the public discovered that some of the first arrivals had a lot to learn about communicating in the New World.

Volkswriter earned its name. It was friendly and affordable and not to be mistaken for a Mercedes-Benz (version 1.2, which appeared last fall, substantially augmented the powers of the program). For many users its greatest virtues were that it worked as advertised and that it was a piece of cake to learn. It had perhaps the most unread manual of any serious piece of IBM software then extant, not because the manual was unreadable but because help messages and a clearly written on-screen tutorial made it practically superfluous.

User-friendliness was the key to *Volkswriter*'s success, and that brings us to the noncircumstantial or nonaccidental aspects of this story. Wilson has been working at user-friendliness since long before the cliche was coined.

He came to this country from Chile in the early 1960s with the intention of studying mathematics at the University of California at Berkeley. He picked up computing as a sideline. Apart from one formal class in compiler writing, Wilson learned programming in the time-honored, reliable fashion—by teaching himself and associating with brilliant people.

"We had a hot little group there," he recalls fondly. "Some of those people went on to do fabulous things."

Wilson learned his trade on such ancestral machines as the PDP-5 and the IBM 1620—machines that made the 1981 pc, even with its lack of programming amenities, look like the essence of geniality. At the same time, he learned how to mediate between the machine and nontechnical people who required its service.

"I supported myself by writing programs for social scientists, people who didn't want to know anything at all about computers," he says.

The Road Not Taken. Perhaps because he didn't follow the customary formal path to programming expertise, through an engineering or computer science department, Wilson managed to retain a view of programming as an individual, creative enterprise. "It's immensely difficult for a group to accomplish anything," he believes. And one might reasonably suppose that his interest in individual fulfillment, in preference to the fulfillment of group goals, had something to do with his temporary abandonment of the computing profession, his embrace of the human-potential movement, and the whole sequence of accidents that led finally to *Volkswriter*.

One is tempted to ask, however, if success will spoil—or change—Camilo Wilson. Can the proprietor of a growing software house resist the impulse to institutionalize and maintain his view of programming as an individual endeavor?

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Wilson appears to believe the answer to the latter question is yes—if only because he's more interested in the merits of whatever project may lie at hand than he is in building a personal business empire.

"I want to maintain a strong emphasis on R&D," he says. "Whether I'll keep that in-house or not, I don't know. But whether in-house, through a merger, cooperation, or some other kind of joint venture, strong R&D is part of the blueprint. I want to keep on doing interesting things."

So what's interesting at this moment?

Spricht es auch Deutsch? An international edition of *Volkswriter*, aimed at Europe and the multilingual market in the United States, is about 95 percent finished and should be on display at this month's West Coast Computer Faire.

"You'll be able to tell the program, 'This is a French document,' or, 'This is a German document,' and the keyboard and printer will then turn French or German." Spanish and Italian versions will follow, and a version for Japanese is also in the works.

The international *Volkswriters* will be table-driven, with a keyboard table and a printer table for each language. There will also be, of course, an on-screen tutorial in each language.

Wilson also hopes to have a *VW Deluxe* ready for release at the Faire. *VW Deluxe* will use whatever amount of memory you have on your machine and will impose no restriction on file size. It will have horizontal scrolling to allow documents wider than eighty characters and will show boldface, underscoring, and page breaks on-screen. "It has all the features I've always wanted to put on a word processor," Wilson allows. Price: unset as of February, but probably in the high two hundreds.

A major departure from the original *Volkswriters*, *VW Deluxe* is coded in Pascal/MT+, instead of IBM Pascal. Wilson says that, like many other programmers, he has a definite preference for Digital Research's languages over Microsoft's; but there's no market for them, because everyone's using PC-DOS. The Pascal/MT+ code of *VW Deluxe* will incorporate some subroutines that will allow the program to run in either operating system—PC-DOS or CP/M-86.

"However," he adds, "if I were starting over I would do it all in C. The next reincarnation of *Volkswriter* will be in C."

After *VW Deluxe*, you can expect to see some word processing accessories from Lifetree.

"First we'll do some kind of *Mailmerge*-type program," he promises. "For some reason people love to send junk mail. What I have in mind, however, will have a far broader range of application than just junk mail. It will be especially useful for contracts and other formal documents."

Later in the year, he expects to be "going after Aspen's tail" (Aspen Software is the publisher of the *Random House Proofreader*). "We'll have an enhanced spelling checker. I don't want to do grammar checking just yet, because I have some ideas about that that will take time to develop. But we'll have a proofreader that will do more than just check spelling; it will also check the mechanical elements of style."

In addition to all this word processing activity, Wilson plans eventually to add an entirely new limb to Lifetree.

"Education is where my heart really is," he claims. "The word processor was a fortunate tangent."

Help Wanted. If it occurs to you that these plans sound a little ambitious for an individual programmer, of course you're entirely right. Wilson is looking for help.

Lifetree is now a company of nine souls, including two programmers besides Wilson. The two, however, are not full-time employees; they live in San Francisco and work for Lifetree on contract.

Lifetree is currently undergoing its second transplantation. Shortly after last year's Computer Faire, the company took up quarters in a landmark office building in the seacoast city of Monterey. Now they're moving around the corner, from one of the oldest buildings in town to a brand-new one.

Silicon Valley apparently hasn't yet extended this far south and west (Digital Research, down the road a piece at Pacific Grove, is the only large computer business in the area). In spite of the fact that Monterey, on a clear day, is one of the most spectacularly picturesque locales this side of Rockport, Massachusetts, Wilson laments that programmers are unwilling to move there.

"The problem is the social life," he believes. "There's nothing here for a single person."

Part of the problem too may be that Wilson has some fairly broad requirements.

"I've noticed," he says, "that there are a few programmers around—like Gary Kildall and Mike Lehman, for instance—who are enormously productive. And I've asked myself, 'Why? What's special about these people?'

"I'm convinced it's a combination of things. Talent helps, of course, but these people also have a variety of skills that they could not have come by in a single programming environment."

And he proceeds to tick off a list of desirable attributes. Diverse technical skills. Facility with operating systems, programming languages, applications. An awareness of the user. And, by implication, some awareness of the noncomputing world and its culture.

One suspects, of course, that Wilson is drawing a self-portrait when he describes the kind of help he wants. If so, his imagination seems to be motivated not by egocentricity but by a distinct and personal vision of what software can and ought to be. One is moved to wish him continued success and happy hunting. ▲

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SUPER PACKAGE: 1-2-3

by Burton Alperson

1-2-3 is a member of a new generation of integrated software. It is an interrelated system of programs capable of many separate tasks—tasks usually considered the province of separate programs. The capabilities of this system include spreadsheet analysis, database management, graphics, report generation, limited word processing, file management, translation of files from one format to another, and text and graphics printing. Data created in any mode of operation are easily available to all other modes.

Previous attempts to produce integrated packages for the pc have, in general, been seriously flawed. Compromise has seemed inevitable. Some packages are agonizingly slow; others lack essential capabilities. Consequently, when an integrated package comes along that appears to have no such compromises and that, indeed, functions better than many of the dedicated programs it can replace, clearly something new and exciting has happened.

This review describes the tasks *1-2-3* can accomplish and compares its performance to that of other software. Since *1-2-3*'s major competition at this time is Context Management Systems's *MBA*, direct comparisons will be made between the two whenever appropriate. Bear in mind, however, that by the time this appears in print version 2.0 of *MBA* will have replaced version 1.4. Some details about 2.0 had already been announced at the time the present review was done; these details will be discussed as appropriate. Meanwhile, *MBA* will receive a full review in these pages after the release of version 2.0.

We'll also be comparing *1-2-3* with the 64K version of *VisiCalc*. This dedicated spreadsheet program was a pioneering accomplishment and therefore serves as a useful benchmark for review of subsequent programs. Because of *VisiCalc*'s popularity, many of *1-2-3*'s spreadsheet functions will be discussed in *VisiCalc* terminology.

Comparisons between *1-2-3*, *MBA 1.4*, and *VisiCalc* are summarized in tables 1 and 2.

Human Engineering. Human engineering is the attempt to increase the efficiency of the operator/machine unit. Applied to software, the term implies the presence of an intuitively obvious syntax, visual displays that communicate quickly and completely, well-written documentation, natural-seeming sequences of operations, high-speed program operation in areas where slowness would cause operator fatigue or irritation, and so on.

Concern for human engineering is evident throughout *1-2-3*. It begins when the program is loaded (in about ten seconds) and you see how *1-2-3* displays its menus. Whenever a menu is relevant, lines 2 and 3 on the screen display both primary and secondary menus in unabbreviated English. A slash command (/), for example, brings up the display in figure 1.

The top line of this display (line 2 on the screen) is your primary menu at this moment. The cursor rests initially on the first option, *worksheet*, and the second line of the display (line 3 on the screen) shows all the suboptions that will become available should you go ahead and select *worksheet* from this primary menu. If instead you move the cursor to *range*, *copy*, or some other item on the primary menu, the secondary menu line changes appropriately. Once you've made your selection from the primary menu, the suboptions move to line 2 on the screen and line 3 presents a plain-English description of each suboption.

Worksheet Range Copy Move File Print Graph Data Quit
Global, Insert, Delete, Column-Width, Erase,Titles, Window, Status
Figure 1.

The first letter of each command in any menu is unique. Consequently you can invoke a command either by moving the cursor and pressing enter or simply by typing the first letter of the command. For quick reference, you can quickly scan all modes and options simply by pressing the slash and cursor-right keys. Beginning your task thus involves at most two keystrokes.

A particularly important feature in the human engineering of *1-2-3* is the existence of on-line "context-sensitive" help screens. An extensive collection of operation guides is contained on the distribution disk. Although it's possible to navigate through the collection to find help on any topic, the first screen displayed is always relevant to the operation being performed at the moment. Thus, if you were attempting to copy *(replicate,* in *VisiCalc* terminology) a row of formulas, and you forgot how to do it, you could press the F1 key and get a help screen with a guide to copying. A press of the escape key clears help messages from the screen and restores you to where you were before you called for help.

1-2-3 rates high marks for protecting users from themselves. Most potentially destructive commands require confirmation from the user. If, for example, you want to save a file under a name that already exists in the disk directory, you have to confirm that you want to overwrite the preexisting file.

The escape key is also used to great advantage in protecting users. In an operation requiring a series of commands, each press of escape erases the action just taken and returns you to the preceding action. Thus no operation is final until you press the entry key.

A self-contained tutorial disk is supplied with the package, and this is the logical starting place from which to start learning about *1-2-3.* The tutorial moves along at the right speed and even manages to introduce some advanced operations. An hour or two with this disk is sufficient preparation for you to begin exploring the power of *1-2-3* with little more than the on-screen prompts of the program proper.

The version of *1-2-3* described here is a prerelease version. Much of the documentation supplied was in an early draft stage and was chaotic. Even so, the program was easy to learn. The human engineering of *1-2-3* is so good that the finished documentation, once read, will probably be used mostly for advanced operations and subtleties.

General Features. Most spreadsheet programs provide predefined functions for frequently invoked tasks. In terms of the sheer number of such functions, *1-2-3* is outstanding: fifty-five functions in comparison to *MBA*'s thirty-five and *VisiCalc*'s thirty. The added functions are nontrivial. The ability to calculate with calendar functions (*date, day, month, today,* and *year*), for example, dramatically increases the range of tasks that can be accomplished without difficulty. The *db-statistical* functions make it easy to create criterion-referenced statistical indexes for subsets of data that share some consistent feature.

The predefined functions contain one of the few disappointments of the package. For some reason, the authors chose to use the biased formulas for the standard deviation and variance functions (this involves the use of N as a divisor, rather than N−1). This decision makes the functions useless for statistical inference and many other scientific applications. (*MBA*'s standard deviation and variance functions also produce the biased values.)

A useful feature of *1-2-3* is its provision for macro definition. This capacity, rare in spreadsheet programs (it's included in the advanced version of *VisiCalc* that runs on the Apple III and that should be available soon for the pc), provides a tremendous increase in power and flexibility. A macro is a sequence of commands invoked by a single command. Any of the alphabetic keys in conjunction with the alt key can be set to invoke a macro. The use of these macros can range from the trivial (the speeding up of typing) to the elegant (the development of full-blown turnkey systems that require no computer expertise on the part of the operator).

Imagine that you have a continuing need to have data entered from an existing form by inexperienced personnel. With a typical microcomputer spreadsheet or database program, the operator would have to be trained in computer operations in a language irrelevant to the data. The task might also require transcription of the data onto special coding forms prior to data entry. The macro capacity in *1-2-3* allows data to be entered to an on-screen representation of the existing raw data form. The cursor can be made to move automatically from one data entry location to the next. When the last datum is entered from the form, the program can automatically save the entry to the database and present a blank form on the monitor, ready for the next series of entries. The potential savings in operator training and error correction afforded by this facility should be obvious.

Spreadsheet Operations. From a user's point of view, the basic concept of a spreadsheet is simple. The computer's memory is treated as though it were a rectangular sheet of paper. Locations on the sheet, called cells, are defined by the intersections of rows and columns. The monitor acts like a window through which one may view the sheet.

Most arithmetic operations that may be performed with pencil and paper may be performed by the computer. Various devices are provided to speed up computerized operations. For example, if a given row contains the sums of thirty-five different columns, the sum formula need only be defined for a single column. A replication function then allows this formula to be defined for the remaining thirty-four columns, by means of a single command. Relationships among cells easily may be defined; thus a change in one cell has immediately visible effects upon all related cells (advertisers like to call this the "what-if" capacity).

1-2-3's liberal use of inverse video provides important visual confirmation of symbolic operations. The imagery is natural and helpful. For example, when you specify a range (a rectangular set of cells), all cells included in the range are highlighted in reverse video. As you expand or contract the range with the cursor keys, the highlighted area immediately reflects the changes in size. Similar display conventions aid in controlling column width, printing, and many other operations.

Table 2 reveals several contrasts between *1-2-3, MBA,* and *VisiCalc.* The differences in capacity are striking. *1-2-3* can deal with more than thirty times as many cells as *VisiCalc* and more than five times as many as *MBA.* This difference is trivial for many applications, like tax modeling or the evaluation of an IRA, but as spreadsheet programs are used more and more for larger operations, such as the tabulating results of experiments or tracking several years' worth of data, these differences in capacity become more important. Capacity is also a critical parameter for *1-2-3*'s database operations—to be discussed shortly. The number of rows that a program like this can address places an absolute limit on the number of records a database can contain. The number of columns places a limit on the number of fields or variables available.

Both *1-2-3* and *MBA* have corrected one of *VisiCalc*'s major flaws: the disallowance of varied column widths within a given model. In *VisiCalc,* if one column is thirteen characters wide, all columns within that window must be thirteen characters. With *1-2-3* and *MBA,* the user has complete control over the selection of column widths (the advanced version of *VisiCalc* reportedly has also remedied this weakness).

Spreadsheet Speed. Because speed is critical in many spreadsheet operations, several performance tests were applied to all three programs. The first test simply involved the time required to load the program. This is a trivial matter if the computer is dedicated to one program. You simply boot the machine in the morning and let it chug along all day.

If the computer is used for various tasks, however, long loading times can become irritating. *1-2-3* and *VisiCalc* are roughly comparable in loading time. *MBA* takes about thirteen times longer to load.

Most commercial and financial spreadsheet operations require many additions and subtractions. To simulate this activity, a performance test was devised that consisted of a Fibonacci series. This is a mathematical series in which each entry is the sum of the preceding two entries. The entire series was made dependent on the value entered in the upper-left cell (A1) of a twenty-by-ten spreadsheet. *1-2-3* completed the series sixty-six times faster than *MBA* and four times faster than *VisiCalc.*

Many scientific applications require exponentiation. Another performance exercise consisted of ten columns in which the programs had to calculate powers of two—from two to the first power to two to the twentieth. *1-2-3* completed the task fifty-three times faster than *MBA* and thirty-three times faster than *VisiCalc.*

Two statistical tests were performed with all three programs. Results of these exercises were consistent with the previous tests. *1-2-3* was dramatically faster than its competition. The parameters of the tests were n=20 for the product-moment correlation and k=3, n=20 for the analysis of variance.

The final performance test was a variation of a torture test devised by Andrew Fluegelman for testing spreadsheet programs. A two-hundred-by-ten matrix was developed in which each column entry was 1.01 times the entry above it. The entire matrix was made dependent on the entry in cell A1. This test pushes spreadsheet programs to their limits. Calculations of this magnitude, however, are not unusual in real-world applications.

This test revealed some important differences among the three programs. Apparently they differ not only in speed but also in the ability to manage available memory. *1-2-3* passed the test with no trouble; the set of calculations was completed in only seven seconds. Neither *MBA* nor the 64K version of *VisiCalc* could complete the test. *MBA* broke down after the second column, and *VisiCalc* quit after the sixth. The 256K version of *VisiCalc* had enough memory to complete the replication, but took thirty-seven seconds to do it—more than five times as much time as *1-2-3* required.

Total time to complete calculations tells only part of the story in these performance tests. The time required to set up the spreadsheets for the tests also showed dramatic differences. The average time necessary to replicate a column in the Fibonacci series was less than one second for *1-2-3*, compared to three seconds for *VisiCalc* and twenty-one seconds for *MBA*. Average column replication time in the powers-of-two test was two seconds for *1-2-3*, compared to thirty-one for *MBA* and seventy for *VisiCalc*. Fluegelman's torture required an average column replication time of five seconds for *1-2-3*, compared to nineteen seconds for *VisiCalc* and two minutes forty-seven seconds for *MBA.*

The times required for replication of columns may be even more important than the calculation times. Setting up a spreadsheet generally involves many replication operations. In the tests described, the replication times would be multiplied by a factor of ten—one for each column. To take one example, the total replication time for *1-2-3* in the powers-of-two test was twenty seconds. Total replication time for the same test with *MBA* was five minutes ten seconds. In fact, the entire series of tests was completed in about one and a half hours with *1-2-3.* The same series of tests with *MBA* required about five hours.

Version 2.0 of *MBA* was not available for comparison. Press releases, however, claim that calculation times for this product will be two to five times better than for version 1.4. The most charitable assumption possible, that all calculations will be speeded up by a factor of five, leads to the prediction that *1-2-3* will still be eleven to thirteen times faster than the new *MBA.*

In sum, *1-2-3*'s spreadsheet performance is superb. The program contains every feature available in the best of dedicated spreadsheet programs. The command syntax is easier to master than that of either of the two programs used for comparison here. The superiority of the program in speed is startling.

Database Operations. A database may be defined simply as any organized collection of information. Database management generally rests on two concepts—records and fields. If you regard a telephone book as a database, all the information about one person would constitute a record. The person's name, address, and phone number would be fields within that record. In the language of various applications, then, a record might be called a case, a person, a subject, a company, an account, a transaction—and so on. The fields might be called variables, descriptors, items, particulars, characteristics, or what have you.

The extension of these concepts to spreadsheet programs is so straightforward and natural that it's difficult to understand why it hasn't been done before. *1-2-3* and *MBA* simply treat each row as a record and each column as a field. For some operations this approach is superior to that taken in the more traditional database programs. Many of the latter, for example, do not allow the field length to be changed once it has been

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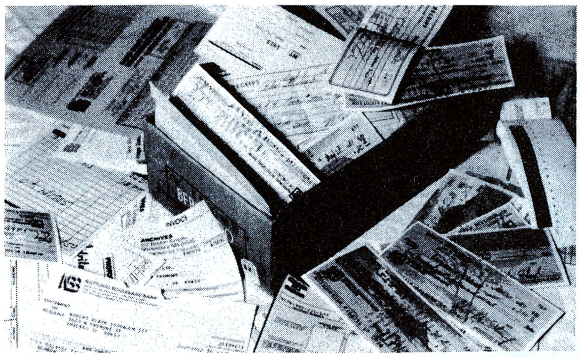

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defined. With the spreadsheet approach, changing field length is simply a matter of altering column width—about five keystrokes.

Practical implications of this flexibility are easy to see. The postal service, which is attempting to expand the number of characters in the zip code, provides a contemporary example. This change would necessitate major surgery on many computerized mailing lists. Those who have implemented their mailing lists with certain database management systems might have to start over and rework the entire database in order to change the length of the zip field. A mailing list implemented with *1-2-3* could accommodate the field-length change in a few seconds.

The advantage of computerized database management, in general, is the ease with which information may be rearranged, selected, summarized, and displayed. Most computerized database managers are capable of placing information in alphabetical or numeric order (ascending or descending) with an operation called sorting. Primitive database managers can select information that's an exact match with a criterion. ("Find the phone number for everyone named Smith.") More powerful programs allow searches for information with a broader range of search criteria. ("Find the medical records for everyone with a diastolic blood pressure between ninety and 110.") The best available database managers allow multiple-criterion searches with logical operators ("Find every case that is male, *and* between twenty and twenty-nine, *and* has a diagnosis of cancer, *or* emphysema, *and* is *not* bald"). None of these operations poses any problems for *1-2-3*. The program can deal with as many as thirty-two criterion fields in a single search operation using any combination of logical operators.

Sort and search operations, like all *1-2-3* operations, are performed with impressive speed. A test database, consisting of eight fields and 111 records, was searched and sorted on various criteria. No operation took longer than five seconds. Sorts used both primary and secondary sorting keys (a primary key is the field on which the first sorting takes place; a secondary key is used to sort fields that share a primary key value). The data were both alphanumeric (consisting of up to twenty-four characters) and numeric. Search criteria were both simple and compound. These variations made little difference to *1-2-3*. There was, at most, a two-second difference among operations, with the fastest performed in about three seconds. It's probable that larger databases would reveal differences among the tasks, but it seems unlikely that any competitive software can approach this performance.

1-2-3 is capable of a broad range of additional database-related functions. The */data fill* command allows you to insert a numeric sequence into a column up to 2,048 rows long. Thus numbering items in a database becomes a simple task. This can be a particularly useful protective feature when you're sorting data. All the records can be numbered before the first sort. If you manage to corrupt the database so badly that you wish you had never begun, you can sort on the number field and restore the original order.

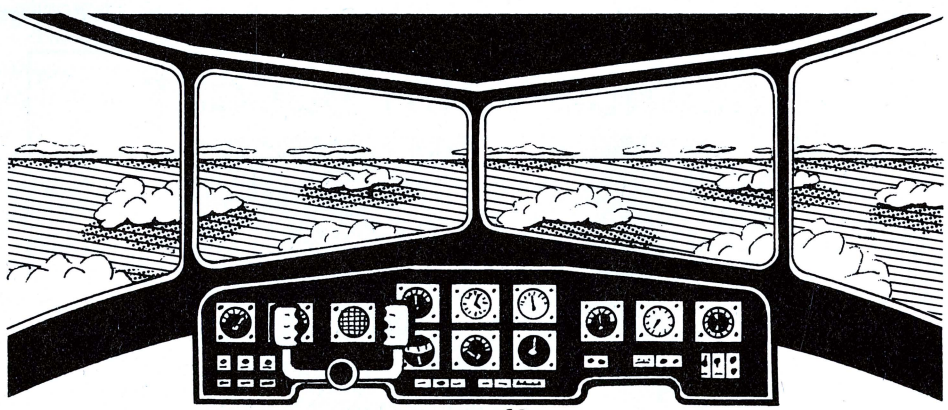
The */data table* command allows the rapid construction of "sensitivity analyses." The */data query extract* command allows any portion of the database to be moved to a new range. This means that it is easy to create any desired subset of data. Once created, this subset may be saved in a file for subsequent work.

File operations with *1-2-3* are also rich. Complete worksheets, databases, formulas, and subsets may be saved and retrieved. Files may be imported and exported from and to *VisiCalc* (in DIF format) and *dBase II*. The program can even work with *VisiCalc* files that are *not* in DIF format (unfortunately, the translation routines to accomplish this were not ready for testing in the prerelease version).

1-2-3's standard file storage mode is not ASCII; the program does, however, include a print-to-file feature allowing you to save an ASCII image of your worksheet and pass it to other programs for further processing. You could, for example, create a table in *1-2-3* and then incorporate it into a document produced on a word processing program. It's also possible to incorporate ASCII files created in other programs into *1-2-3* models or databases. This process is termed "foreign correspondence" in *1-2-3*.

There are a few limitations in *1-2-3*'s database management capabilities. There can be no more than thirty-two criterion and output fields, and the program is restricted to rectangular databases; it cannot deal with hierarchical or relational structures. These limitations will not bother the majority of microcomputer users.

Graphics. *1-2-3* is capable of turning spreadsheets into graphic displays with little difficulty. The available graph types include line graphs, bar graphs (histograms), stacked bar charts, pie charts, and "xy plots" (scattergrams). These graph types are the familiar traditional graphic representations. All types except the xy plots can display up to five "data ranges" or independent variables; xy plots are by definition limited to two variables.



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Color can be used to enhance the graphs, and all graphs may be printed by means of a utility supplied with the program. This utility, called Graphprint, supports the Epson MX-80 and MX-100 (hence also the IBM) and the IDS Prism printers; it also supports the HP 7470A plotter. These peripherals may be addressed through two parallel and two serial ports. Thus it's possible to have four different devices, serving four different purposes, connected to the system at once; *1-2-3* allows selection among them with a few commands.

The Graphprint utility provides control over colors, page width and length, and print fonts. It also allows you to control the size of the figure on the page. The figure may be rotated to produce graphs in any orientation—

Table 1: Predefined Functions in 1-2-3, VisiCalc, and MBA

FUNCTION	TYPE	1-2-3	VISICALC	MBA	RETURNS:
ABS	Math/trig	Yes	Yes	Yes	Absolute value
ACOS	Math/trig	Yes	Yes	Yes	Arccosine
AND	Logical	Yes*	Yes	Yes	Boolean AND comparison
ASIN	Math/trig	Yes	Yes	Yes	Arcsine
ATAN	Math/trig	Yes	Yes	Yes	Arctangent
ATAN2	Math/trig	Yes	—	—	Arctangent (4 quadrant)
AVG	Statistical	Yes	Yes	Yes	Arithmetic mean
CHOOSE	Special	Yes	Yes	Yes	Selected cells
COPY	Special	Yes**	—	Yes	Import values from disk file
COS	Math/trig	Yes	Yes	Yes	Cosine
COUNT	Statistical	Yes	Yes	Yes	Frequency
DATE	Date	Yes	—	—	Days since 0-Jan-1900
DAVG	DB-statistical	Yes	—	—	Arithmetic mean of selected cells
DAY	Date	Yes	—	—	Day number
DCOUNT	DB-statistical	Yes	—	—	Frequency of selected cells
DMAX	DB-statistical	Yes	—	—	Maximum value of selected cells
DMIN	DB-statistical	Yes	—	—	Minimum value of selected cells
DSTD	DB-statistical	Yes	—	—	Biased standard deviation of selected cells
DSUM	DB-statistical	Yes	—	—	Sum of selected cells
DVAR	DB-statistical	Yes	—	—	Biased variance of selected cells
ERR	Special	Yes	Yes	Yes	Err
EXP	Math/trig	Yes	Yes	Yes	Natural exponent
FALSE	Logical	Yes	Yes	Yes	0
FV	Financial	Yes	—	—	Future value
HLOOKUP	Special	Yes	—	—	Row lookup
IF	Logical	Yes	Yes	Yes	0,1 as consequent
INT	Math/trig	Yes	—	Yes	Truncated integer
IRR	Financial	Yes	—	Yes	Internal rate of return
ISERR	Logical	Yes	Yes	Yes	0,1 as a function of presence of ERR
ISNA	Logical	Yes	Yes	Yes	0,1 as a function of presence of NA
LN	Math/trig	Yes	Yes	Yes	Log base e
LOG	Math/trig	Yes	Yes	—	Log base 10
LOOKUP	Special	—	Yes	Yes	Lower-right lookup
MAX	Statistical	Yes	Yes	Yes	Maximum value
MIN	Statistical	Yes	Yes	Yes	Minimum value
MIRR	Financial	—	—	Yes	Modified internal rate of return
MOD	Math/trig	Yes	—	—	x MOD y
MONTH	Date	Yes	—	—	Month
NA	Special	Yes	Yes	Yes	NA
NOT	Logical	Yes*	Yes	Yes	Logical complement
NPV	Financial	Yes	Yes	Yes	Net present value
OR	Logical	Yes*	Yes	Yes	Boolean OR comparison
PI	Math/trig	Yes	Yes	Yes	Pi
PMT	Financial	Yes	—	—	Payment per period
PV	Financial	Yes	—	—	Present value
RAND	Math/trig	Yes	—	—	Uniformly distributed random number
ROUND	Math/trig	Yes	—	—	(Controls accuracy of computations)
SIN	Math/trig	Yes	Yes	Yes	Sine
SQRT	Math/trig	Yes	Yes	Yes	Square Root
STD	Statistical	Yes	—	Yes	Biased standard deviation
SUM	Statistical	Yes	Yes	Yes	Sum
TAN	Math/trig	Yes	Yes	Yes	Tangent
TODAY	Date	Yes	Yes	—	Current date in days since 0-Jan-1900
TRUE	Logical	Yes	Yes	Yes	1
VAR	Statistical	Yes	—	Yes	Biased variance
VLOOKUP	Special	Yes	—	—	Column lookup
YEAR	Date	Yes	—	—	Years since 1-Jan-1900

*This action is available within a database context, not as a built-in function.
**This action is available within a file operations context, not as a built-in function.

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All graphing operations, whether on monitor or printer, may be invoked with automatic scaling of axes. However, this scaling easily may be overridden and brought under user control.

1-2-3, like *MBA*, provides for simultaneous displays of spreadsheets and graphics. With this capacity, you may use the graphic display to get a feel for trends and immediately examine the spreadsheets for fine detail. The two programs take different approaches to achieve the result. *MBA* places all information on the color monitor and allows the screen to be split between graphic and spreadsheet displays. *1-2-3* uses the color monitor exclusively for graphics, if both color and monochrome are installed. The spreadsheet, in that case, is displayed on the monochrome monitor. If the system has only a color monitor, the display may be alternated between spreadsheet and graphics.

The tradeoff between these two approaches is cost against power. *MBA*'s solution means that hardware cost can be reduced by six hundred to seven hundred dollars, since a monochrome monitor isn't needed for simultaneous display of spreadsheet and graphs. Operator fatigue, however, is increased, because of the inherent lower resolution of color monitors for text work. In addition, more information can be displayed at once with the *1-2-3* approach, since two full screens are available. *MBA*'s hardware cost advantage is offset somewhat by the fact that the program itself costs two hundred dollars more than *1-2-3*.

Evaluation of graphics capabilities must take place on two levels, relative and absolute. Compared to its competition, *1-2-3*'s performance is excellent. While *MBA* does provide two more graph types than *1-2-3* (high-low and area), this advantage is offset by *MBA*'s more difficult syntax and slow speed. *1-2-3* is, in fact, far easier to use than some dedicated graphics programs that produce equivalent results.

In an absolute sense, some desirable features are not included. *1-2-3* cannot superimpose a calculated function on the data displayed. The usefulness of the xy plot, for example, could be increased if it were possible to superimpose a regression line on the data.

It is also puzzling that no advantage is taken of high-resolution graphics. All the displays are in medium resolution, which places strong restrictions on the complexity of available graphics. With high resolution, the screen could be split for multiple panel displays. This would be a tremendous aid in scientific applications, such as the understanding of complex interactions in the analysis of variance.

But in fairness to Lotus, it must be pointed out that *1-2-3*'s competition cannot accomplish these tasks either. Perhaps it's best to regard the tasks as a wish list for future revisions.

Summing It Up. The most difficult task facing a reviewer with a package like *1-2-3* is restraint of enthusiasm. This program is so rich and so well implemented that a brief review can only hint at its potential. It is difficult to believe that a single piece of software can do so many things so well. Human engineering, speed, power, and flexibility make it a pleasure to use.

The highest praise one can bestow on a program is that it quickly feels like an extension of oneself. *1-2-3* allows you to focus on your work, rather than on your tools.▲

***1-2-3**, by Mitch Kapor and Jonathan Sachs (on-screen tutorial by John Posner), is available from Lotus Development Corporation, 55 Wheeler Street, Cambridge, MA 02138 (617-492-7171) for $495.*

Table 2: 1-2-3, MBA, and VisiCalc Comparisons

	1-2-3	MBA	VISICALC
PRICE:	$495	$695	$250
MINIMUM REQUIRED HARDWARE:			
Central memory	128K	256K	64K
Disk drives	1 double	2 single	1 single
Display:			
Without graphics	Mono or color	Mono or color	Mono or color
For graphics	Color	Color	—
For simultaneous text and graphics	Mono and color	Color	—
CAPACITIES:			
Rows x Columns	2048 x 256	999 x 95	254 x 63
Cells	524,288	94,905	16,002
Database records	2048	999	—
Individual column widths	Yes	Yes	No
Nonabbreviated prompts	Yes	No	No
Primary and secondary menus displayed	Yes	No	No
Context sensitive on-line help	Yes	Yes	No
Macros	Yes	No	No
Asynchronous communications	No	No*	No
Split screen (number of windows)	2	4	2
PERFORMANCE:			
Loading time	10 sec	2 min 15 sec	16 sec
Fibonacci series	1 sec	1 min 6 sec	4 sec
Powers of 2	3 sec	2 min 40 sec	1 min 41 sec
Product moment correlation (r)	1 sec	1 min 1 sec	23 sec
One-way analysis of variance (F)	1 sec	1 min 15 sec	34 sec
Fluegelman's Torture: time	7 sec	Aborted	Aborted
Fluegelman's Torture: cells completed	>5000	>400	>1400

*Context Management Systems has announced that version 2.0 of MBA will have asynchronous communications capacity.

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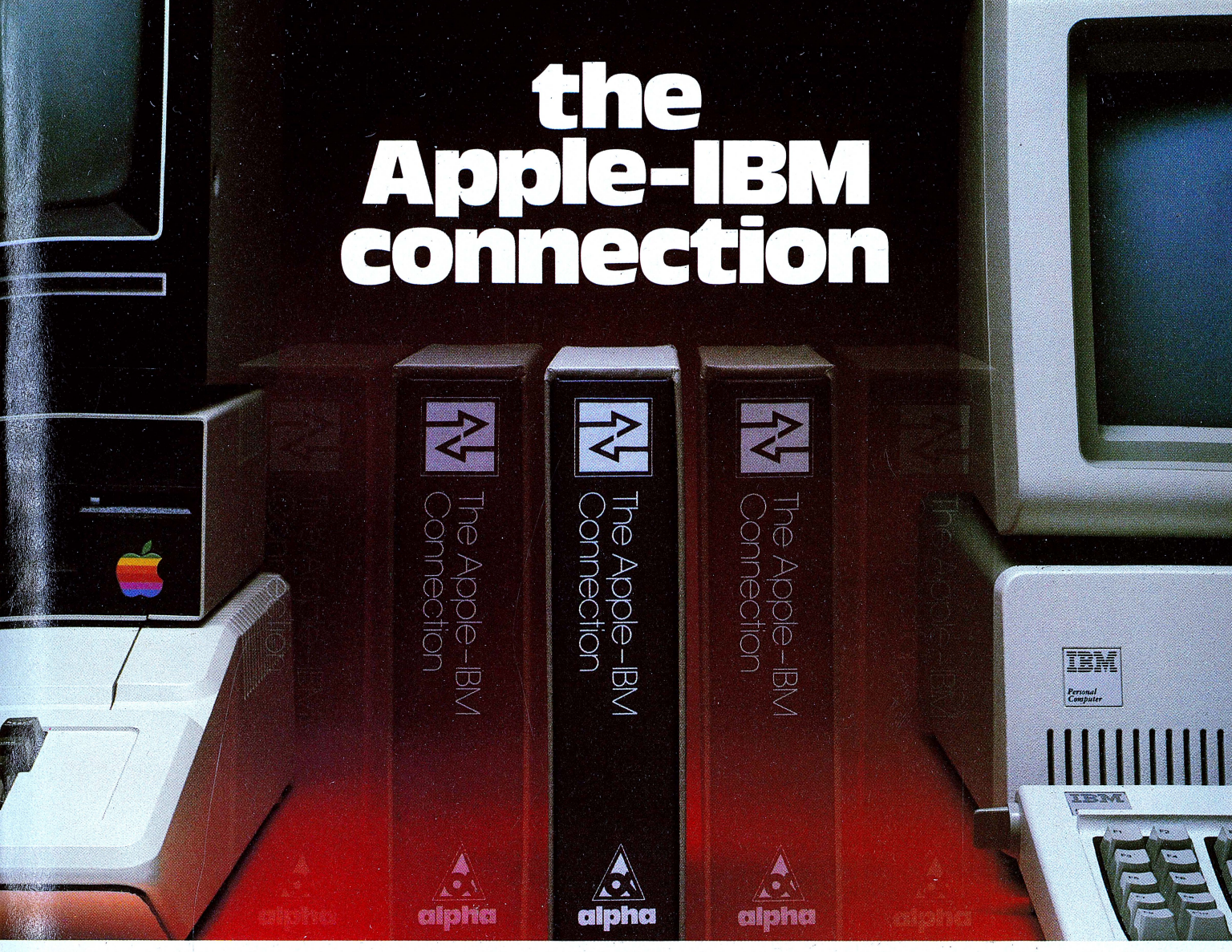

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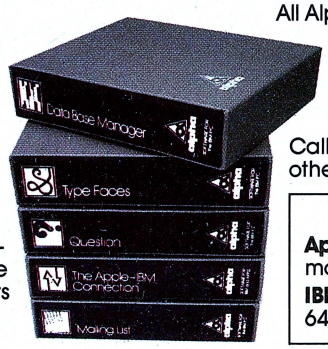

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ATTACK OF THE PRINTER BUG

by John Socha

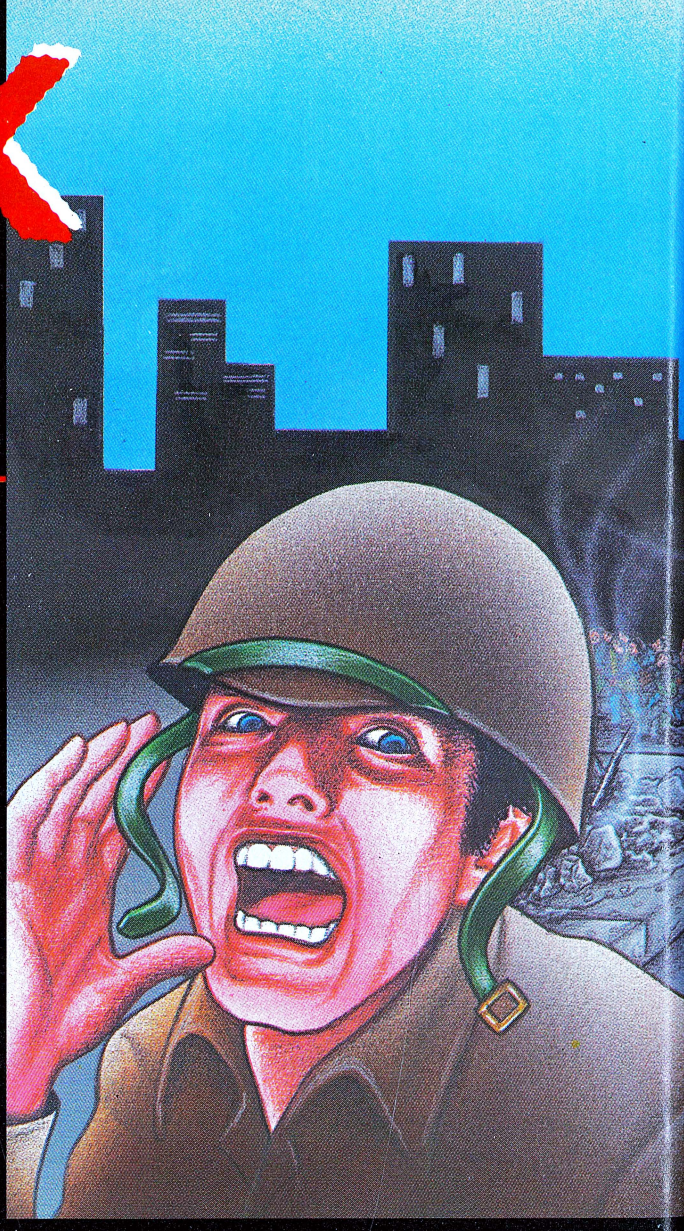


Illustration by Mike Cressy

The bug in the parallel printer routines supplied in ROM has been fixed, so they say (Snooping in ROM: Which Version Did You Get? by Peter Norton, *Softalk*, January '83). Well, it has and it hasn't. Under certain conditions, these routines still drop characters sent to the printer.

The newer ROM has fixed matters so that DOS waits a little longer before dropping characters; but it still drops them. In Basic the problem is worse than in DOS; where DOS drops individual characters, Basic discards whole listings!

We're going to explore the conditions that lead to lost characters or listings. Then we'll build a program to patch DOS and Basic to prevent lost characters. Although the patch program is written in machine language, don't worry. You need no knowledge of machine language to build Printfix.com—the program to exorcise the printer bug in the parallel printer routine. On with the exploration.

In Search of the Printer Bug. For this sojourn you'll need a printer attached to a parallel printer adapter in your pc. The printer doesn't have to be connected to the monochrome adapter board; it can be hooked up to any board with a parallel printer adapter. Let's try two simple experiments. Switch on the power to your printer and place the printer on line—ready to print. The on-line light should glow patiently.

Sit down at your pc and start DOS 1.1. Then reach over and push the button to place your printer off line. The on-line light should wink out. Now the printer is *not* ready to print, but we're going to try sending characters anyway. Why? To find the nest of the printer bug, that's why. More on this after our first test.

We are going to send some characters to the printer, using the copy console command. Here we go. At the prompt, type:

A>COPY CON: LPT1:

Press enter. On the next line type

testing

Press enter, then press the F6 key. A ^Z, indicating end of input, will appear on the next line.

Now be patient. After sixteen* seconds, an error message will appear:

printer fault

Now quickly switch the printer back on line. On your monitor you'll see

1 File(s) copied

A >

On the printer's output you'll see that *testing* is missing the initial "t" and reads *esting*. What happened to the "t"?

When placed off line, the printer sets a signal telling the computer to be patient—the printer's busy and it's not ready to print characters. This is a "busy" signal, what else? DOS waits patiently for sixteen seconds, then issues a "printer fault" message. For some reason, DOS discards one character and then tries to print the next character. Why does it discard one character? Ask IBM. Every sixteen seconds, you'll see a printer fault message and DOS will discard another character. Try it.

So why should this bother us, you say, if we have sixteen seconds to switch the printer on line before DOS discards any characters? Because there are situations where sixteen seconds may not be long enough. But first let's see how Basic deals with this overly long busy signal.

Once again, turn the printer off line first. Now, enter Basic and type

LPRINT "test"

After eight** seconds, your monitor will show an error message:

Device Timeout or **Device Fault**

Ok

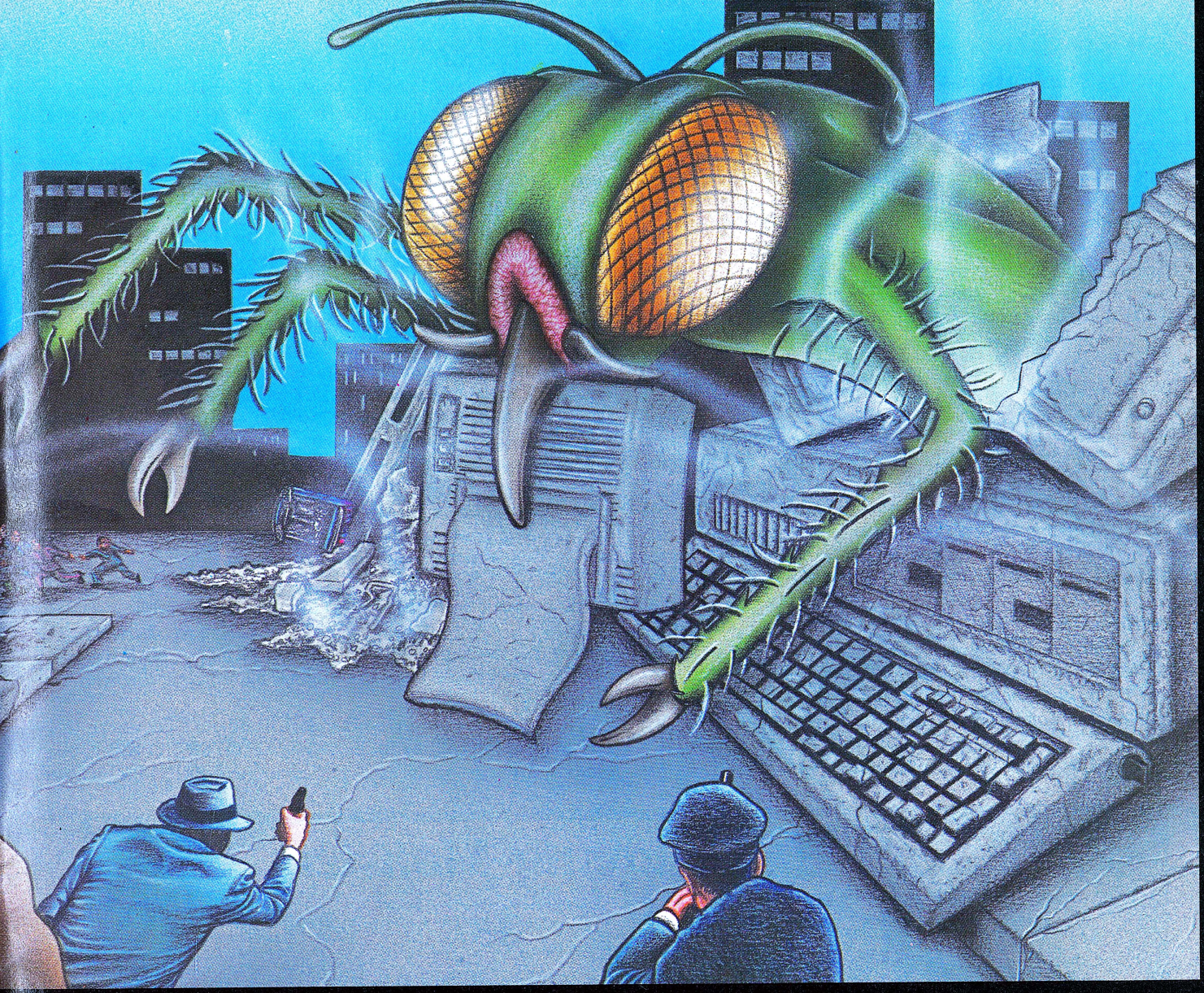
Basic waits only eight seconds before issuing an error message. Impatient. But *then* Basic has the gall to discard the rest of the output; hence the Ok prompt. It's now too late to set the printer on line. Try it.

Now let's see why this might create disasters, and then see how to cure DOS and Basic of this bug.

The Bug's Nest. Most printers have a buffer to store characters waiting to be printed. What happens if this buffer is filled faster than the printer can print characters? The printer sends a "busy"

*If your pc contains a newer version of ROM, the elapsed time will be thirty-two seconds. (See Peter Norton's article for more details.)

**Sixteen seconds for the more recent ROM.



signal to the pc saying "stop sending characters." Now, if the printer has a large buffer, this can lead to problems. Here's how.

Both the printer fault and device timeout errors described above appear when the printer stays busy for too long—about sixteen seconds from DOS and eight seconds from Basic. Let us say your printer has a 2K buffer and prints at forty characters per second (these figures are for an F10 Starwriter with a 2K buffer). Such a buffer takes fifty seconds to empty—more than enough time for a printer fault (device timeout). And it happens! The Starwriter doesn't send a ready signal until the buffer has just thirty characters left. One way to circumvent the problem is to pause the processor (with Control-numlock) until all the characters in the buffer have been printed. But who wants the bother?

The Vaccine. There is a machine-language routine in the ROM BIOS that handles printer output. It is this routine that waits for a ready signal from the printer. And it's this routine that's so impatient, waiting only eight seconds before declaring a fault. It seems that DOS has the heart to try a second time before discarding a character, while Basic is somewhat ruthless in not retrying. They can both be fixed by rewriting the ROM BIOS routine. The modified version supplied here is infinitely patient: it will wait until a ready signal appears, even if it has to wait for hours or days—the story of a faithful dog. More details later.

Here is the program to generate the file Printfix.com.

```
10   CHECK=0 'Check to see if data is correct
20   FOR I=1 TO 112
30   READ BYTE
40   CHECK = CHECK XOR BYTE
50   NEXT I
60   IF CHECK=242 THEN 100 'Data OK, create
     PRINTFIX.COM
70   PRINT "One of the data statements may be wrong"
80   PRINT "Check lines 1000-1130, then run again"
90   STOP
100  OPEN "printfix.com" AS #1 LEN=1
110  FIELD #1,1 as BYTE$
120  RESTORE
130  FOR I=1 TO 112
140  READ BYTE : LSET BYTE$ = CHR$(BYTE) : PUT #1
150  NEXT I
160  CLOSE
170  PRINT "PRINTFIX.COM created"
180  END
1000 DATA 186, 112, 1, 184, 0, 0, 142, 216
1010 DATA 184, 21, 1, 163, 92, 0, 140, 200
1020 DATA 163, 94, 0, 205, 39, 251, 30, 82
1030 DATA 86, 190, 64, 0, 142, 222, 139, 242
1040 DATA 209, 230, 139, 148, 8, 0, 11, 210
1050 DATA 116, 12, 10, 228, 116, 12, 254, 204
1060 DATA 116, 44, 254, 204, 116, 20, 94, 90
1070 DATA 31, 207, 80, 238, 66, 236, 168, 128
1080 DATA 116, 251, 176, 13, 66, 238, 176, 12
1090 DATA 238, 88, 80, 139, 148, 8, 0, 66
1100 DATA 236, 138, 224, 128, 228, 248, 90, 138
```

```
1110 DATA 194, 128, 244, 72, 235, 216, 80, 131
1120 DATA 194, 2, 176, 8, 238, 184, 232, 3
1130 DATA 72, 117, 253, 176, 12, 238, 235, 219
```

Run this program once to create Printfix.com; you won't need the Basic program again. You don't even need to save this Basic program (if you do save it, don't name it Printfix.com, or you'll wipe out the machine-language routine the Basic program is intended to create).

Injecting the Vaccine. Now that you've got the vaccine, Printfix.com, what do you do with it? Inject it into the patient? This is somewhat close to the truth. We'll simply tack Printfix onto the end of DOS and, in the process, we'll increase DOS by 368 bytes. Let's do it.

Return to DOS and type

A>CHKDSK

Chkdsk, as described in the DOS manual, returns a count of the total memory in the machine (65,536 in a 64K system) and the number of bytes free. This last number will change when we attach Printfix.com to DOS. Yes, attach. Printfix.com actually becomes a part of the operating system. Free memory will decrease by 368 bytes. This affects only the version of DOS in memory, not on the disk, so you'll have to attach Printfix after each time you boot DOS. Now type

A>PRINTFIX

Now, at the prompt again type

A>CHKDSK

See how the amount of free memory has dropped by 368 bytes. If you type *printfix* again, free memory will decrease yet another 368 bytes, but you'd gain nothing from running Printfix twice.

Now, try the testing exercises we started with. You'll see that neither "printer fault" nor "device timeout" appears, even after an hour with the printer off line—we've exorcised the printer bug! Three cheers and pat the dog.

You'll probably want to place a call to Printfix in your Autoexec.bat file so the bug will be exorcised each time you start DOS. Just add the line

PRINTFIX

to your Autoexec.bat file.

The Vaccine's Formula—Technical Details. In this section we'll be discussing the hard-core details of the machine-language program, so if you have no interest in machine language, there's no need to continue reading. Enjoy the rest of this issue.

The assembly-language routine is shown on page 41. It's very much like the routine PRINTER_IO, which starts on page A-42 of the *Technical Reference* manual. In fact, we begin by entering PRINTER_IO verbatim and writing the short routine PRINTER_FIX to set the INT vectors and attach our version of the routine to DOS. The labels B1:, and so on, have been changed to make PRINTER_IO more readable. Sections of the original PRINTER_IO, used unmodified, have comments with a space directly after the semicolon. For example:

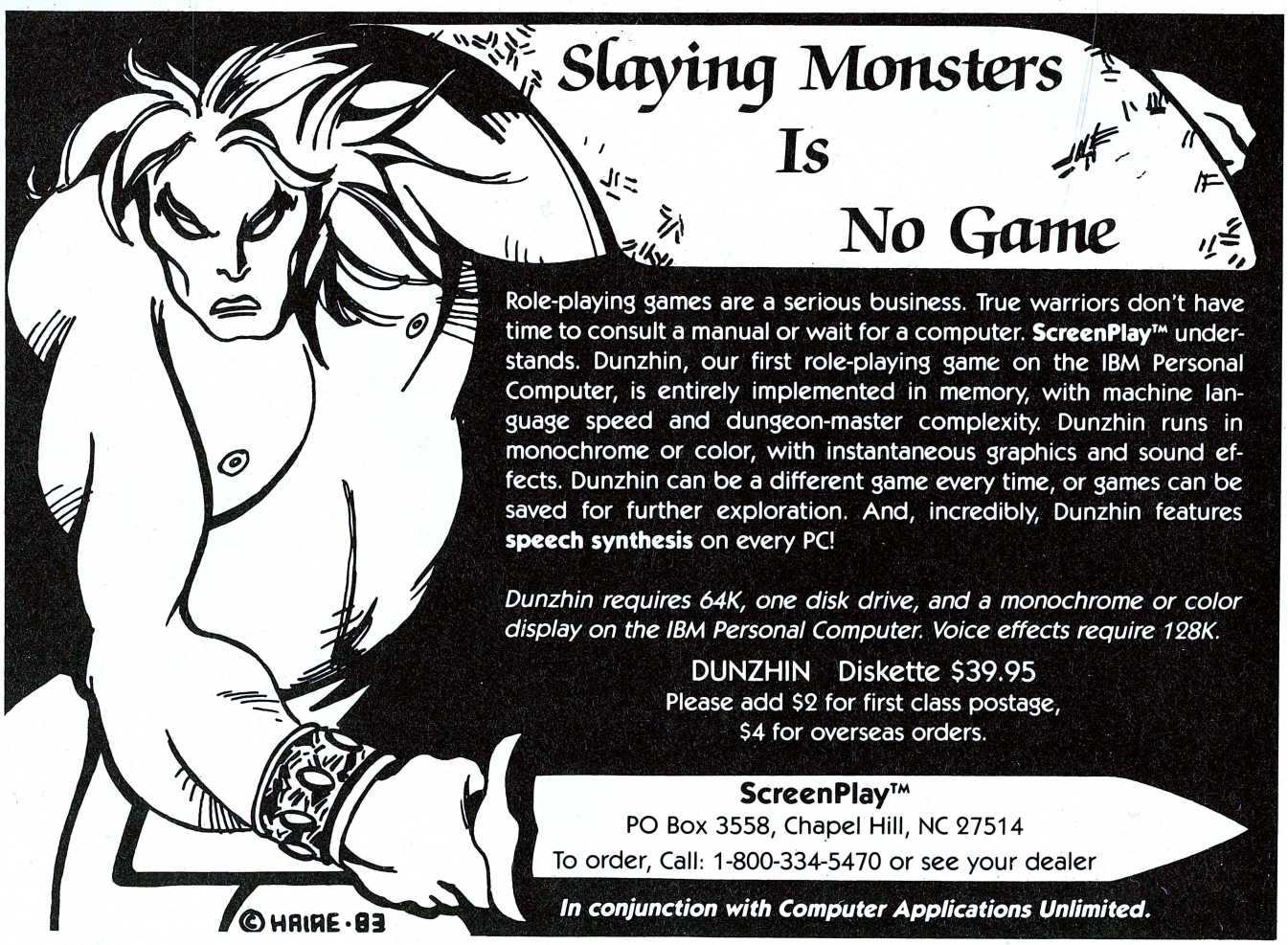
```
PUSH    DS                      ; Save registers
```

is a line from the original PRINTER_IO routine, while

```
PUSH    AX                      ;Save character
```

is from the new routine PRINT_CHAR. PRINT_CHAR has been modified extensively from the original B2: routine. On with the details.

Here's how the routine works. Both Basic and DOS use an INT 17H interrupt to call the BIOS routine PRINTER_IO which, yes, sends a character to the printer. The original PRINTER_IO has



been changed so that the interrupt vector at 17H*4 now points to our new routine. This is done by PRINTER_FIX just after the line

```
ASSUME      DS:VECTORS
```

The single instruction before this line loads the DX register with the first address after the new PRINTER_IO; this lets DOS know where it can load user programs. The address becomes the new end-of-DOS address after the INT 27H instruction. INT 27H returns to DOS and allows this routine to stay resident. So far, we've attached the new PRINTER_IO routine to the end of DOS and changed the INT 17H vector to direct printer I/O to our routine.

Now for the changes in PRINTER_IO. All the important changes are in the routine CHECK_BUSY. It is here that the old routine (B3:) flagged a timeout error. But now, if the printer is busy, the routine will try again—for as long as it takes the printer to become ready. Sections of PRINTER_IO that were needed only by routine B3: have also been removed. For a more detailed understanding of these routines, compare this version of the program with the original version on page A-42 of the *Technical Reference* manual and experiment.

```
;--------------------------------------------------------------------------------;
  This program corrects the bug in the printer routine: the timeout-delay time is too short for some
  printers with large buffers. This set of replacement routines has an infinite delay time.
;--------------------------------------------------------------------------------;

  Interrupt vector for printer routine

VECTORS SEGMENT AT 0
        ORG         17H*4
PRINTER_VECTOR      LABEL   DWORD
VECTORS ENDS

  Initialize printer vector and attach to DOS

CSEG    SEGMENT PARA
        ASSUME CS:CSEG
        ORG         100H                    ;Set starting point for a COM file.
PRINTER_FIX         PROC    FAR
        ASSUME      DS:CSEG
        MOV         DX,OFFSET END_PROG      ;Set DX to first byte after program
                                            ;to tell DOS the end of program
        ASSUME      DS:VECTORS
        MOV         AX,VECTORS              ;Set up vector for INT 10H BIOS call.
        MOV         DS,AX                   ;PRINTER_IO below will replace the
        MOV         AX,OFFSET PRINTER_IO    ;routine in the ROM BIOS.
        MOV         PRINTER_VECTOR,AX
        MOV         AX,CS
        MOV         PRINTER_VECTOR[2],AX
        INT         27H                     ;Terminate but stay resident.
                                            ;Adds this code to DOS.
  ROM BIOS data area

DATA    SEGMENT AT 40H
RS232_BASE          DW      4 DUP(?)
PRINTER_BASE        DW      4 DUP(?)        ;Addresses of printers
DATA    ENDS

        ASSUME      CS:CSEG,DS:DATA
PRINTER_IO          LABEL   NEAR            ;Used by the initialization routine above.
        STI                                 ; Interrupts back on
        PUSH        DS                      ; Save registers
        PUSH        DX
        PUSH        SI
        MOV         SI,DATA
        MOV         DS,SI                   ; Establish printer segment
        MOV         SI,DX                   ; Get printer parameters
        SHL         SI,1                    ; Word offset into table
        MOV         DX,PRINTER_BASE[SI]     ; Get base address for printer card
        OR          DX,DX                   ; Test DX for zero, indicating no printer
        JZ          RETURN                  ; No print, so return
        OR          AH,AH                   ; Test for (AH)=0: print character
        JZ          PRINT_CHAR              ; Print the character store in the AL register
        DEC         AH                      ; Test for (AH)=1: initialize printer
        JZ          INIT_PRT                ; Initialize the printer
        DEC         AH                      ; Test for (AH)=2: return printer status
        JZ          PRT_STATUS              ; Printer status
RETURN:                                     ; Return from INT 10H
        POP         SI
        POP         DX
        POP         DS
        IRET

;----- Print the character in AL

PRINT_CHAR:
        PUSH        AX                      ;Save character
        OUT         DX,AL                   ;Output char to port
        INC         DX                      ;Point to status port

CHECK_BUSY:
        IN          AL,DX                   ;Get printer status
        TEST        AL,80H                  ;Is the printer currently busy?
        JE          SHORT CHECK_BUSY        ;Yes, try again
        MOV         AL,0DH                  ;No, set the strobe high to send
        INC         DX                      ;Strobe is bit 0 of port C of 8255
        OUT         DX,AL
        MOV         AL,0CH                  ;Set the strobe low
        OUT         DX,AL
        POP         AX                      ;Recover the output char

;----- printer status

PRT_STATUS:
        PUSH        AX                      ; Save AL reg
GET_STATUS:
        MOV         DX,PRINTER_BASE[SI]
        INC         DX
        IN          AL,DX                   ; Get printer status
        MOV         AH,AL
        AND         AH,0F8H                 ; Turn off unused bits
                                            ; STATUS_SET
        POP         DX                      ; Recover AL reg
        MOV         AL,DL                   ; Get character into AL
        XOR         AH,48H                  ; Flip a couple of bits
        JMP         RETURN                  ; Return from routine

;----- Initialize the printer port

INIT_PRT:
        PUSH        AX                      ; Save AL
        ADD         DX,2                    ; Point to output port
        MOV         AL,8                    ; Set init line low
        OUT         DX,AL
        MOV         AX,1000
INIT_LOOP:
        DEC         AX                      ; Loop for reset to take
        JNZ         INIT_LOOP               ;
        MOV         AL,0CH                  ; No interrupts, non auto lf, init high
        OUT         DX,AL
        JMP         GET_STATUS              ; PRT_STATUS_1

END_PROG            LABEL   BYTE            ;The first address after the program
PRINTER_FIX         ENDP
CSEG    ENDS

END     PRINTER_FIX
```

▲

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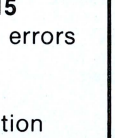

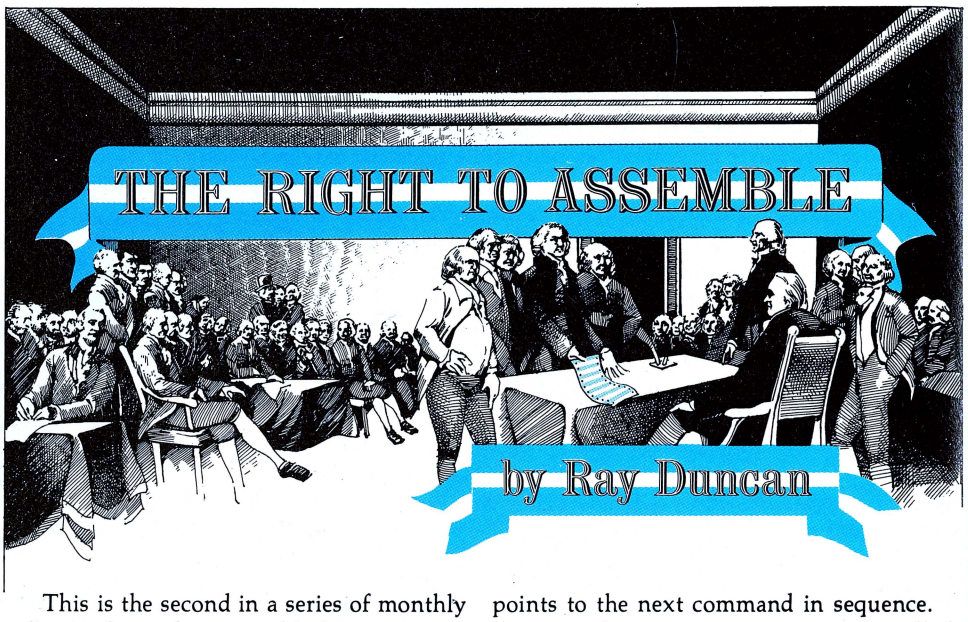

This is the second in a series of monthly columns devoted to assembly language programming on the Intel 8088 microprocessor, which is the heart of the IBM Personal Computer. This month we'll take a very general look at the computer's internal architecture; subsequent columns will cover this material again in a much more technical manner.

Computer Basics. At the most primitive level, the central processor of any conventional computer may be thought of as consisting of a few black boxes that perform very specific functions in very rigid ways. These components include the *instruction pointer*, an *accumulator*, an *execution control unit*, an *adder*, and a read/write storage area that can be randomly addressed.

The storage area is usually referred to as *random access memory*, or RAM; a few of us old-timers still call it "core." It consists of a collection of pigeon-holes, or "cells," each of which can hold one item of information and can be accessed by a unique number, which is called the cell's location, or *address*.

Every location in RAM is completely general in purpose and can hold either a program instruction or a piece of data. The processor's execution control unit decodes program information, so that it knows what sequence of operations it's to carry out; data is manipulated by the computer in a variety of ways, depending on the context in which it appears.

The instruction pointer tells the computer which location in RAM holds the next command of the program currently being executed. When the contents of this next location are fetched from memory, the execution control unit decodes the binary number to determine what operation is to be performed. Normally, after a program step is decoded and executed, the instruction pointer is automatically incremented so that it points to the next command in sequence.

Special program instructions called *branches* or *jumps* cause the instruction pointer to be modified, so that the next command is taken from some location in memory other than the next command in sequence. Branches can be *conditional*; that is, the instruction pointer may or may not be modified, depending on the result of some previously executed operation or on the value of some specified item of data. This capability, of course, is necessary so that the execution of a program can be flexible and appropriate to the data being processed.

Finally, the accumulator is a special, extremely fast storage location separate from RAM; it's used to hold an item of data while it is being inspected or modified. The adder works together with the accumulator to combine two pieces of data into a new result. Nearly every operation that a computer performs, whether it be a shift, a rotate, a subtraction, a multiplication, or whatever, can be expressed mathematically as some sequence of additions.

The primitive architecture just described is sometimes called a *Van Neumann* machine. The crucial points for our purposes are (1) that the actions of the machine are determined by *software* and can be changed by simply putting new information into memory, (2) that the machine does one thing at a time in a very rigidly sequential manner, and (3) that any location in memory can hold either data or program.

That last point—that memory locations can hold either data or program instructions—is very important, since it causes much loss of sleep for new programmers and veterans alike! If by some error in coding the instruction pointer winds up pointing to an area of memory that contains variable data, the machine will always try to interpret the data as program commands. This situation

usually causes the program to crash in some totally unpredictable way, which may even vary from one invocation of the program to another, depending on the data that's fed to the program.

Specifics of the Intel 8088. The 8088 microprocessor, being of modern design, is much more complex than the simple Van Neumann model just described; but each of its pieces, taken alone, is readily understandable.

There are eight fairly general-purpose *registers*, or internal storage locations, which can serve as accumulators and can also be used in calculation of memory addresses. There are four special *segment registers* that can be modified by the program and that are employed *only* for the calculation of memory addresses. There's also a *flags register*, in which each individual bit has a special significance and is turned on or off automatically as a side consequence of arithmetic or logical operations on data. Finally, there is an instruction pointer, which indicates the address of the memory location containing the next program command to be executed.

Each of the 8088's internal registers, including the instruction pointer, is sixteen bits wide. This means that the basic unit of information, or *word*, that can be manipulated by the 8088 may be any unsigned number between 0 and 65,535 or any signed number between 32,767 and −32,768. From this fact you might conclude that the maximum number of memory locations that can be accessed by the 8088 is also 65,535 (usually referred to as 64K). However, it turns out that memory addresses are always created by the 8088 from the combination of one of the segment registers and another number; the latter number may be part of the program information or may be contained in one of the general-purpose registers. The result is that 8088 addresses are actually twenty bits in length, so the 8088 has the power to specify a single memory cell out of a range of 1,048,575 locations—one megabyte.

Eight-bit or Sixteen-bit Processor? Even though the 8088 can comfortably manipulate data internally sixteen bits at a time, all of its data interchange with random access memory or peripheral devices is done eight bits at a time. This is the only difference between the 8088 and its bigger brother, the 8086, which can talk to the outside world in sixteen-bit quantities. The eight-bit data paths allow the 8088 to be combined in microcomputer systems with the older and less expensive eight-bit peripheral controller circuits.

You will often see caustic comments by manufacturers of other microcomputers to the effect that the IBM pc is not really a sixteen-bit computer, since its memory accesses are done in eight-bit chunks. The fact that many of the programs that were initially released for the pc (including Microsoft Basic) performed no better than their 8080 or Z-80 predecessors has been used to support this specious argument. In reality, the processing power of the 8088 is vastly greater than that of an 8080 or Z-80, and when the programs are properly optimized by someone with a thorough understanding of the 8088, a dramatic increase in performance can be achieved.

The deciding factor on whether a microcomputer is a sixteen-bit machine or an eight-bit one is really the width of the arithmetic and logical operations on data that are present as a symmetric set of machine instructions. The size of the channel to memory is irrelevant, since with the addition of a few extra integrated circuits any type of memory can be interfaced to virtually any type of central processor. One of the early IBM 360 computers at the bottom of the product line had an eight-bit memory bus, but no one claimed that it was an eight-bit computer.

Interesting Features of the 8088. A significant innovation in the architecture of the 8088 was the partitioning of the central processor into an execution unit (EU), which decodes and carries out program commands, and a *bus interface unit* (BIU) that handles all communications with the external random access memory and the I/O devices. When the execution unit is busy performing some operation on data contained in the machine's internal registers, the bus interface unit occupies itself fetching ahead as many as six program instructions. Thus, when the EU is ready to decode another program command, that command usually has already been brought inside the central processor so the EU can start work on it immediately. This pipelining of instructions is common in large mainframe computers, but its introduction into a microcomputer represents a major achievement.

In addition, the 8088 was designed to be used in multiprocessor configurations, where several computers are tied together, sharing common memory and dividing up the work to be done according to each computer's resources. Two special-purpose coprocessors for use with the 8086 or 8088 have already been introduced by Intel: the 8087 Arithmetic Processor, which performs extremely fast floating-point arithmetic, and the 8089 Input/Output Processor, which can perform high-speed data transfers between memory and complex peripheral devices.

Next month's installment will include a detailed discussion of each of the 8088's general-purpose and special-purpose registers, as well as a description of the processor's various addressing modes. ▲

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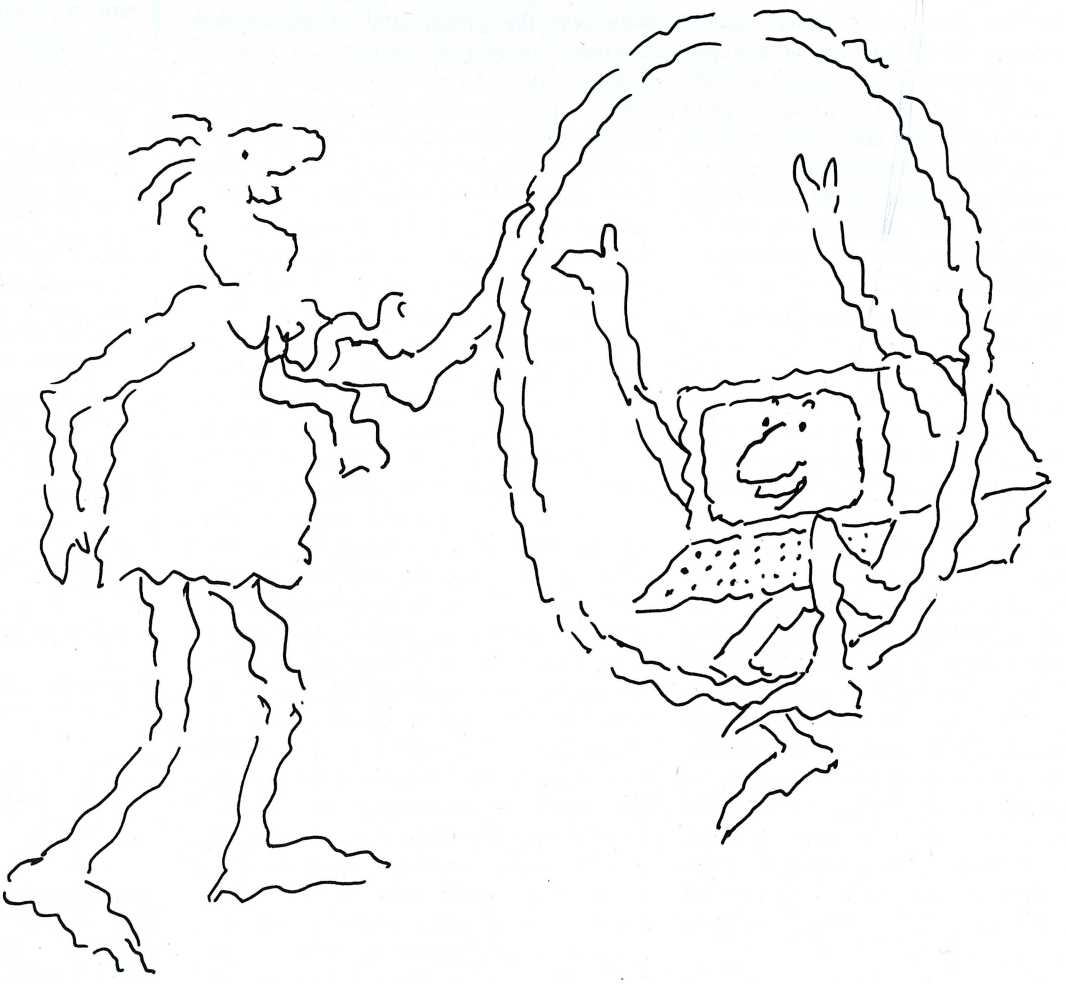

Meet 1-2-3 – the remarkable new software package that puts more raw power at your fingertips than anything yet created for the IBM PC. 1-2-3 actually combines information management, spreadsheet, and graphing in one program that can perform all three functions interchangeably and instantly at the touch of a key. That's power.

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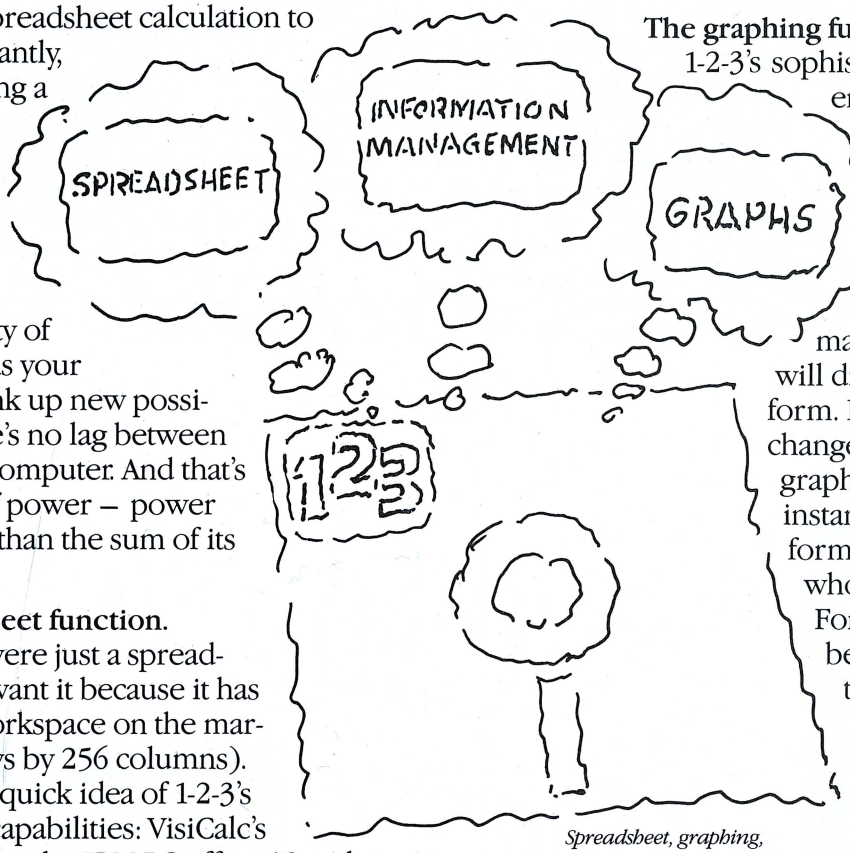

Spreadsheet, graphing, information management all-in-one.

The spreadsheet function.

If 1-2-3 were just a spreadsheet, you'd want it because it has the largest workspace on the market (2048 rows by 256 columns). To give you a quick idea of 1-2-3's spreadsheet capabilities: VisiCalc's spreadsheet for the IBM PC offers 15 arithmetic, logical and relational operators, 28 functions and 32 spreadsheet-related commands. 1-2-3 has 15 operators, 41 functions and 66 commands. And if you include data base and graphing commands, it actually has 110!

In addition, 1-2-3 is up to 50 times as fast as established spreadsheets. With all the features you've ever seen on spreadsheets. 1-2-3 also gives you the capability to develop customized applications (with 26 macro keys) and lets you perform repetitive tasks automatically with one keystroke. If 1-2-3 were just a spreadsheet, it would be a very powerful tool. But it's much, much more.

The information management function.

Add to 1-2-3's spreadsheet a selective information management function, and the power curve rises at an awesome rate. Particularly since 1-2-3's information management capability reads files from other programs such as WordStar, VisiCalc and dBase II. So you can accumulate information on a limitless variety of topics and extract all or pieces of it for instant spreadsheet analysis. Unheard of before. Specific 1-2-3 information management features include sorting with primary and secondary keys. Retrieval using up to 32 criteria. 1-2-3 performs statistical functions such as mean, count, standard deviation and variance. It can produce histograms on part or all of the data base. 1-2-3 also allows for the maintenance of multiple data bases and multiple criteria.

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To fully understand just how much power 1-2-3 adds to the personal computer you'll want to go to your nearby 1-2-3 dealer for a full demonstration. For his name and address (and more information if you want it) call 1-800-343-5414.

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INSIDE IBM: BUILDING 226

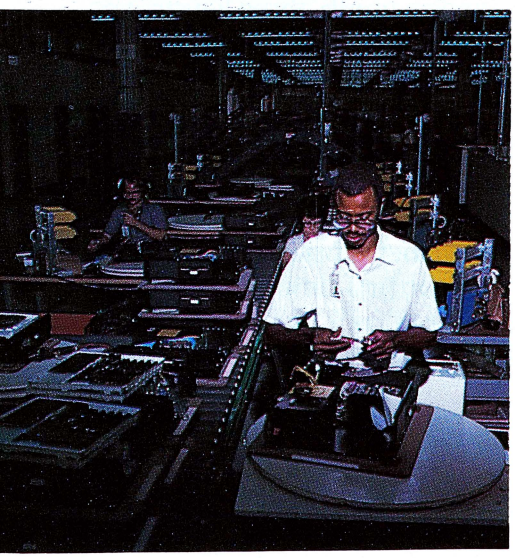
by Douglas Clapp

Interstate 94 slices up the east coast of Florida like a knife—up from Miami, through Fort Lauderdale, into Delray Beach and Boca Raton, before cutting through a rare patch of almost open countryside.

Scattered across this fast-developing area are the seventeen buildings that constitute IBM's Entry Systems Business, birthplace of the IBM Personal Computer and home of the only pc assembly plant in North America (system units only; keyboards are manufactured in North Carolina and monitors are made in Taiwan).

The buildings are massive, modernistic two-story blocks. Your first impression is that this is not a casual operation, an impression confirmed once inside. Security is rigid; clearance badges for employees are mandatory. Visitors wait in a cavernous lobby until met by an approved escort.

You're about to take a look at the assembly of the pc. A multitude of authorizing signatures on the proper form are required, but after only a slight delay you've got a security badge and an escort, and you're ready to begin.



On this tour, you're accompanied by D. J. Scherer, whose title is program manager, press relations. A model of helpfulness and courtesy, Scherer will stay with you throughout your tour, explaining, focusing your attention on particular points of interest, and sometimes politely turning aside any question that IBM would rather not answer. The questions that IBM would rather not answer are those concerning numbers: how many Personal Computers have been shipped, how many are assembled in an hour, how many pass/fail any given test, how many. . . . Well, you get the idea.

Onward to building 226, where you discard any preconceptions you have about assembly lines and manufacturing plants. Personal Computers are assembled in an antiseptically clean and surprisingly quiet building of one hundred thousand square feet. It was constructed just last year and designed from the ground up for pc assembly.

You're joined here by W. R. Gibson Jr., the auto (for automatic) line manager. Gibson oversees the entire assembly process, everything from quality control to personnel management. He will answer your technical questions—unless, of course, they're about numbers.

The assembly procedure begins in a storeroom where the FRUs are kitted.

One More Time? FRU is IBMese for *field replaceable unit*, defined as those parts of a pc supplied by outside manufacturers and easily replaced in the "field" by your friendly computer dealer. FRUs include everything from the pc's disk drive to the power supply to the cord that plugs into the wall outlet. Interestingly, it's difficult to find anything in a pc that isn't an FRU.

Kitting is the unboxing of all the FRUs—everything from disks to speakers—and the arranging of them on a plastic tray. Then, a pc "kit" is ready for assembly. And it truly is a kit. Even the main circuit board comes out of a box preassembled.

Three kinds of Personal Computers are assembled here: single drive, dual drive, and cassette interface, although not many of the last. Most assembly trays contain either single or double-sided drives, depending on demand. The most common unit contains one drive, a disk-drive card, and 64K of RAM memory. Additional cards, including either a monochrome or color graphics card, are installed by the retailer.

The kitting room is a no-photo area, perhaps because the pc is supposed to be made from IBM components. Photographs might reveal all those boxes with other manufacturers' names on them. After all, this is an IBM computer, right?

As you watch, trays of unassembled Personal Computers move out of the kitting room on stainless-steel rollers to either a manual or an "auto" line. There's little difference between the two. The auto line isn't totally automated (not yet, at least). For now, the major difference between the two lines is a robot (which you'll see later) and the auto line's automatic movement of trays.

This isn't a Detroit assembly line where a worker's whole day may consist of repeatedly installing the same part. Here, each pc is assembled entirely by one person. A maximum of twenty workers, ten on each line, build them one by one.

IBM, preferring not to answer the question of how many each worker can assemble in one hour, says only that each employee has an hourly production target. Don't say you heard it here, but a good guess might be eleven per hour per employee. Shifts run twenty-four hours a day, five days a week. How's your arithmetic?

A quick, efficient, almost effortless assembly appears to have been a prime consideration in the pc's design. And, although repetitive, it is still an individual process. Workers are encouraged, after learning the traditional method, to customize their own assembly procedure. (If you think working on an assembly line is a dead-end job, talk to Gibson, the young man in charge of the entire process. He started his career with IBM ten years ago—on the assembly line.)

After each stop on the assembly line, the pc is wanded, much like supermarket items at a checkout counter. Wanding is overseen by an IBM Series 1 computer, which contains a database of information about each pc that comes off the line. If you look on the

back of yours, just above the keyboard cable socket, you'll see a bar-coded slip of paper. It identifies, among other things, which worker assembled the unit.

Incidentally, if yours is a new pc, the yellow warning sticker on the power supply is in five languages: English, German, Spanish, Italian, and French. Is this a clue to IBM's marketing plans, or merely an indication that we live in a multilingual society? What do you think?

(*Editor's Note*: On January 18, two weeks after this tour, IBM announced the beginning of overseas shipment of Personal Computers to Hong Kong and fifteen countries: Singapore, Saudi Arabia, Austria, Belgium, Denmark, France, Germany, Ireland, Italy, the Netherlands, Norway, Spain, Sweden, Switzerland, and England.)

The pc now moves down the line for burn-in and diagnostic calisthenics. Results are fed into the Series 1 databank.

The diagnostic tests stretch each of the pc's components. Should any part fail, the pc is taken off the line and further diagnosed by—you guessed it—another pc. A typical diagnostic message reads: "Replace power supply. Run diagnostics. Return unit to conveyor if diagnostics pass." Gibson adds that the diagnostics used here are "essentially the same program as the one supplied with the pc."

Next, the pc encounters a robot that clamps on the system unit backplate and then lifts the pc onto a large rack capable of holding seven hundred fifty of them. Time for a "hi-pot" test. The hi-potting is a high voltage (or high potential) applied to the system unit's metal case. The test ensures that users won't be electrocuted by their Personal Computers and earns IBM its Underwriters' Laboratory label.

If no failures occur, the pc is removed from its carousel, again by a robot, and undergoes one final test.

This time, the pc is fed abnormally low and high levels of line current. Its designers wanted a machine that would work flawlessly, even when the electric power isn't optimum. The test ensures that your pc will perform under conditions you'll probably never experience.

Tests complete, the pc receives its diploma, a rugged metal cover.

This part of the pc's journey is almost over. It's been kitted, assembled, burned-in, tested, retested, and retested again. If it's a typical pc, it's passed each test; very few fail. Those that do fail are fixed, retested, and retested. Quality control is the primary consideration. Gibson points to the cable that gives each worker the power to stop the entire line. "Productivity is important," he adds, "but the biggest consideration is quality. If you don't have quality, productivity doesn't mean a thing."

For the final step of the process, the pc moves along the line to a boxing station. Here, with only a little help from a human friend, a robot encases the pc in a shipping carton designed to protect it from falls of up to three feet.

The boxed pc is carried along until it finally disappears through a hole in the wall. "Over the wall" marks the end of the assembly process. What began as cartons of separate parts at one end of the building is now heading down a ramp at the other. Wall to wall, a pc's journey takes, on average, five hours.

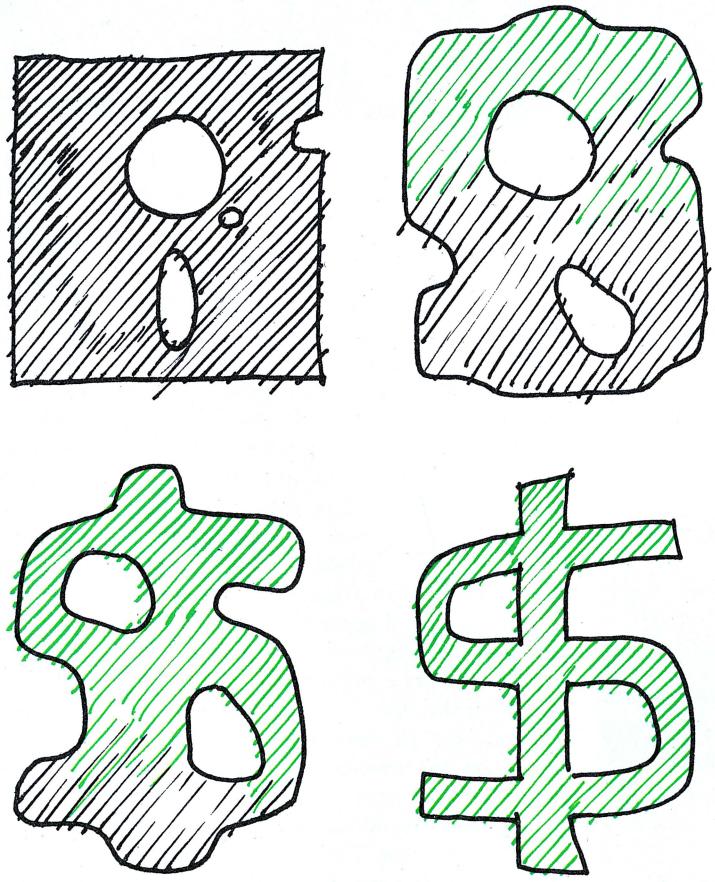
On the other side of the wall, in the hot Florida sun, are nine loading docks. Here the pc begins another journey, one that will take it to one of over six hundred retail outlets and end in the home or office of a new IBM Personal Computer owner.

You, meanwhile, turn in your badge, bid goodbye, and head back to your own pc—somewhat more impressed than before. As you suspected, the folks at IBM know what they're doing. ▲

Photos by Hal Charms

THE FLOPPY TAX CONSULTANT
or
HOW TO SAVE A BUCK AT TAX TIME

by Allan Tommervik



On some perverse metaphysical level, there's a natural law that commands programmers to spew forth microcomputer versions of Form 1040 for our horror and/or edification.

Apparently the syllogism goes something like this: computers are good at number crunching. Form 1040 has lots of numbers. Therefore, Form 1040 must belong on the computer.

Never mind that our pc is a friend, toy, companion, workmate, object of affection. Let's put it to a task that annually subjects us to fear, dread, and loathing. Transferring our distaste for Form 1040 to our pc may be too high a price to pay for getting that wretched task accomplished. Nevertheless, nearly a dozen software publishers are asking us to do exactly that.

We'll take a look at their efforts in this article and an accompanying one next month to see what territory each publisher has attempted to stake out and how each goes about doing it. It's important to understand the publisher's target marketplace because, although all the programs will competently delineate your tax liability, it's definitely not the case that a tax program is a tax program is a tax program.

For purposes of simplification, tax packages can be sorted into three general categories. There are programs that primarily aim at doing your current (1982) taxes with additional features aimed at future tax planning. A second group of programs features the planning aspects of income taxation, but will deign to execute a 1982 Form 1040 at your request. A third set of programs aims directly at tax professionals and are designed to automate their approach to tax planning and tax calculations for a large client base.

Obviously, the features included in the program and the approach taken to the problem of tax calculations vary with the objective of the program. It's basically those variations that will be discussed, because all of the programs to be mentioned work with the information the user feeds in. It's how the programs put the questions to you, and how the documentation amplifies on those questions, that separates them.

All of these programs are dependent on your ability to provide quality data. The reason that H & R Block has grown into one of America's largest enterprises is that it has successfully ingrained in us the notion that we aren't tax professionals. When we do our own taxes, we're costing ourselves money. Sure, they cost seventy-five dollars, but they save us two hundred fifty dollars or more. According to them, we owe it to ourselves to consult a tax specialist.

If you've swallowed that line, you're reading the wrong article. Because one thing you won't get from a personal tax-preparation package is the kind of tax consultation you'll get from a true tax professional. On the other hand, you may get as much help as a chain-store operation might proffer.

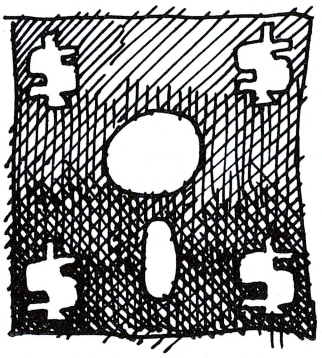
If you're willing to do the work yourself, including getting all the IRS pamphlets and forms that will aid in your understanding of the process, read on.

One of the things that research will make clear is that your pc

isn't necessarily a write-off itself. The software you use to prepare your taxes definitely is deductible. But not necessarily the computer itself.

According to Laura Myers of the Los Angeles IRS Public Affairs office, the crucial issue in determining deductibility is the extent to which you ply the pc in earning your living.

If it's an integral part of your business, it's totally deductible. If 50 percent of its use is for income-producing activities, 50 percent of its cost is deductible.



Even on that, points out Myers, there's a limit. You can't take more than five thousand dollars in one year. So if you've stocked up on hard disks and expansion boards, you'll have a carry-forward for next year as well.

The IRS hasn't ruled on whether the keeping of an electronic diary would be adequate proof of expenditures, but Myers ventured that if the diary were maintained regularly and reasonably soon after a deductible event, it would have some influence with auditors.

What that might imply to pc owners is that date-stamping of tax diary entries would be a strategically wise tactic.

This article looks at four packages that are directly aimed at helping the personal user prepare tax forms. Those programs are:

TaxCalc, by Precision Financial Systems, published by Morgan Computing Company, 10400 North Central Expressway, Suite 210, Dallas, TX 75231 (214-739-5895). *TaxCalc* is a comprehensive *VisiCalc* template that can also be used for tax-planning purposes.

1982 VisiCalc Tax Preparation Models, by Pansophics, Ltd., distributed by Professional Software Technology, Box 269, Rockport, MA 01966 (617-546-2073). *Tax Models* is purely a tax-preparation template that overlays either *VisiCalc* or *SuperCalc*.

Tax Manager, by TASO, published by Micro Lab, 2310 Skokie Valley Road, Highland Park, IL 60035 (312-433-7550). *Tax Manager* is a detailed approach to individual tax preparation that can also be used to keep a tax diary for the following year.

TaxCut, by Theresa Baudier, Linda Givens, and Michael Kaczmarski, published by United Micro Systems, Box 3035, Tucson, AZ 85702 (800-251-2320). *TaxCut* is a tax-preparation program with a fairly strong tax-planning capability.

Two tax planners and three tax preparation packages aimed at tax professionals will be covered next month. The tax planners are *TaxMode* by Sawhney Software and *Personal Tax Planner* by Electronic Data Systems. Both will prepare 1982 tax forms as well as plan for 1983.

The professional packages are *Micro-Tax* from Microcomputer Taxsystems, *Plan 1040* from Software 1040, and *Professional Tax Plan 2.4* from Aardvark Software.

All the programs were tested on the same hypothetical taxpaying couple, with one spouse working and one self-employed. They own rental property, earn interest on savings and dividends from stocks, and have lost money in the stock market during the last year. Their filing is a joint return.

The approaches of the four programs to this problem are interesting. *Tax Models* from Pansophics and *Tax Manager* don't care whether the user is single or married, filing jointly or separately. One program adapts to all.

TaxCalc and *TaxCut* load up a different program for each of the filing possibilities. For these two packages, comments will pertain only to the joint filing module. All modules are enclosed in each package.

Taxpayers accustomed to filling out their own forms will feel right at home with *Tax Models* from Pansophics. What they'll get for their one hundred dollars is a spreadsheet template that almost exactly duplicates Form 1040.

The user is expected to have done the requisite homework to determine what the proper entry is for each line. *Tax Models* is a whiz at crunching your numbers, but you'll still have the agony of researching all the pamphlets for explanations of what is or isn't deductible, as well as where it should go on the form.

The advantage of the program is its tidy appearance on the screen. Even a novice spreadsheet user can follow the flow of data; and even that little guidance is often help enough to get through the tax chore.

On the other hand, if you've been depending for years on your accountant to come up with the right numbers, this may not be the package for you. Terse is too grand a description of the documentation. Pansophics lays no claim to being a tax consultant.

Form 1040 must be filled out by hand after using the template for calculations. *Tax Models* requires 64K.

TaxCalc gives the spreadsheet user more template for the same one hundred dollars, but may lose the novice in the bargain.

Form 1040 and several substantiating forms and schedules are spread across nearly fifty columns and down more than fifty rows. Working through the maze can be treacherous for the beginning spreadsheet user who doesn't read documentation.

TaxCalc has double or triple the documentation of *Tax Models*, but mostly it's confined to methodology. Considering the complexity of the model, that's a necessary concomitant to success, but the taxpayer is left on his own to follow such instructions as, "Fill in the

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appropriate amount, if applicable." No good tax advice here.

On the other hand, the presence of the various forms and schedules provides a guide for successful tax preparation, and the documentation encourages you to proceed in a logical, orderly fashion.

Methodology for processing tax forms is the intimidating part of doing tax preparation. Looking at that blank form only leaves most folks bereaved of any idea of where to start. There's not all that much mysticism in tax preparation. After all, the data your tax consultant juggles is your own. So having a road map on how to proceed is half the battle.

Experienced spreadsheet users will find a great deal of satisfaction in using *TaxCalc*. It's a model with real sophistication that uses every bit of the 128K it requires. It's quite a thrill to hit "!" and see all those deductions get calculated.

As with *Tax Models*, you'll have to transfer the data to Form 1040 by hand. But the additional schedules and forms on the spreadsheet allow the user to get more detailed printouts for personal use than is possible with *Tax Models*.

TaxCalc takes advantage of its spreadsheet origins to play "what if" with 1983 tax data. Morgan provides the tax rate tables for 1983 to be substituted for the 1982 rates in the spreadsheet. At that point, you can enter likely data for 1983 to see what the future holds. As you develop real data to replace with your best guesses, a reliable picture of next year's tax liability begins to unfold.

The planner module is spreadsheet application of a high order and, as such, significantly enhances *TaxCalc*.

If you don't own a spreadsheet, or if you want a lot more help on the tax-guidance side of the effort, then one of the other two packages will be more your cup of tea.

Tax Manager pretty much lives up to its name. From the start, its goal is to give you as much handholding as is possible on floppy disk.

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At your request, it will pose a series of questions, much as your tax consultant does. From your answers, the program will inform you of what ancillary forms and schedules you should fill out along with 1040.

That's a great start toward winning the battle. Even better is that *Tax Manager* is a menu-driven program that offers you the chance to fill out each of the forms it recommends. Then the data is passed to other parts of the program.

Even a numbskull can get his taxes pretty much correct with that kind of guidance.

Micro Lab went even farther, however. The manual is fairly detailed in explaining what income must be reported and what deductions are allowable. In fact, the program is so complete and the documentation on tax matters so thorough that it lulls the user into a false sense of security.

If you changed jobs during the year, it's altogether likely that too much FICA tax was deducted by your various employers. There's nary a mention of this common hazard in *Tax Manager*, nor is there the provision to check for overpayment in the program.

One annoying aspect of *Tax Manager* is its refusal to skip unneeded items. Once you've said you're filing a joint return, you should be spared the necessity of strolling through the other reporting options to get to the next germane question on the screen.

Tax Manager redeems itself by allowing you to scroll screen by screen through each module, sparing you the requirement of tarrying over matters already disposed of.

Tax Manager has extensive ability to maintain detail lists supporting various facets of income and deductions. Used in a systematic fashion, that capability will have your 1983 taxes half done by the end of the year. That's not to purport that this is a full-fledged planning package hidden in preparation clothing. It's one of those fillips that add value to a Micro Lab package.

Tax Manager requires 64K and retails at two hundred fifty dollars. It's worth every penny of it for the pc owner who needs the handholding to get through tax season with confidence.

TaxCut also seeks to serve those folks who want more help than a spreadsheet can give them, and it goes the extra mile in its attempt at service.

The documentation on the program is as lucid as any in microcomputerdom. And it's annotated with references to guide the user to the best source of information on the subject at hand.

Armed with the *TaxCut* manual and various government reference works, anyone with a reasonable command of the King's English should be able to take advantage of every possible tax loophole.

TaxCut also makes a favorable impression on-screen. Its presentation is clear and uncluttered, making trivial the task of understanding what's at stake. It's a truly professional effort from a young publishing firm.

TaxCut assumes more of the burden for itself than do the other packages reviewed here. It'll catch that overpayment of FICA tax. Or at least it will now. The earliest version promised to catch it in the documentation, but blew it in the execution. It's been fixed and revisions issued to all owners. If you own the package and missed the revision, give the company a call.

The dual-earner deduction that the other programs leave up to you to figure out is also automatically calculated where it is appropriate.

TaxCut requires 128K and a two-sided drive. It retails for two hundred fifty dollars, and rarely has a new company brought forth a product so worthy of such a high ticket. If United Micro Systems has anything else up its sleeve of similar quality, it'll be a force to reckon with.

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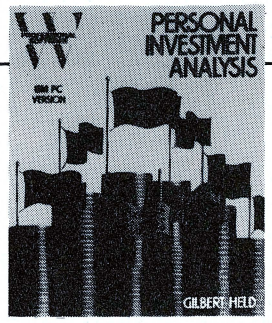

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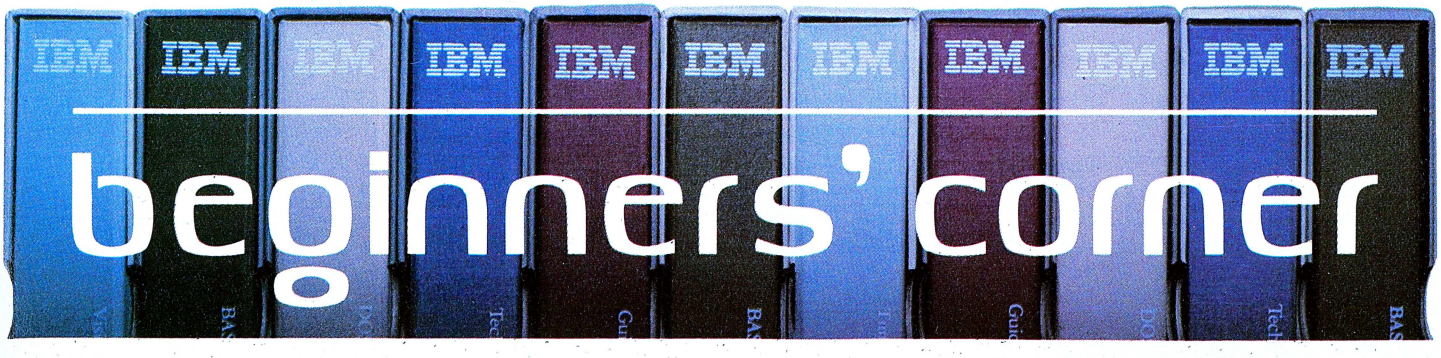

by Craig Stinson

So you've got this sea of bits inside your machine—anywhere from a couple hundred thousand of them to some nine million, depending on the amount of memory you bought. How do all these 1s and 0s get to be *Flight Simulator*, or *1-2-3*, or (God forbid) Edlin? What bit of wizardry turns bits into *Wizardry*?

Obviously these questions are a little heavy to be answered fully here. But let's just blunder along as though they weren't.

Commands. What makes the computer conceptually different from your file cabinet is the fact that it can store instructions as well as data. That is to say, in addition to storing nouns, like your processed words and your crunched numbers, it can also store and act upon a whole vocabulary of verbs.

The 8088 microprocessor chip, which is the brain of your Personal Computer, has been hard-wired to recognize certain binary values—certain patterns of bits—as commands. This fundamental, built-in instruction set is the machine language of the computer, the only language it can act upon directly (without the help of a translator). The instruction set is unique to the 8088 (well, almost unique; the closely related Intel 8086 microprocessor understands the same instruction set); other microprocessors, like the 6502, the Z-80, and the 68000, have their own entirely different instruction sets, which is one reason programs written for Apples or TRS-80s won't run on pcs.

The operations encoded by the instruction set are exceedingly elementary. The microprocessor has several internal bins, called *registers*, that act as temporary holding areas for data that it's working on or with. Some of the fundamental actions of the computer involve the transfer of a value from one register to another or between a register and a specified memory address; others perform arithmetic operations upon the contents of a register and some other number; still others manipulate the contents of a register directly—for example, by changing all the 1s to 0s and vice versa.

Certain instructions, called conditional branches, cause the microprocessor to perform some kind of comparison—one register's contents against another's, perhaps, or one register's contents against zero—and modify its subsequent behavior in accordance with the outcome of the comparison. It is these instructions that enable the computer to be responsive to the outside world—that allow it to act as if it knew how to make decisions. Without branch instructions, your pc could only do trivial tasks.

It's a long way from elementary actions such as these to a complex performance like *Wizardry*, but the construction of a computer program ultimately means the orchestration of memory contents in such a fashion that these fundamental instructions—and the data upon which they're to operate—get served to the microprocessor in the proper order.

Instruction Pointer. It would be appropriate to ask at this point how the computer distinguishes a noun from a verb. If instruction set codes are held in memory alongside data, and if the machine has no special flags, but only 1s and 0s, how does it tell one animal from the other?

Only by context. The microprocessor has a special-purpose register called the instruction pointer, whose contents at all times direct the microprocessor to the address in memory from which it's to fetch its next command. As one instruction is being executed, the contents of the instruction pointer are changed and the next instruction is brought in from memory.

Most instructions involve more than one byte of memory. For example, if you want the microprocessor to move a number from one location to another, you have to supply it a verb (the move command), a direct object (the number it's to move, or the location whose contents it's to move), and an indirect object (the destination). In computer parlance the verbs are called *op codes* and the various nouns involved—the direct and indirect objects—are called *operands* or *arguments*.

Instructions vary in complexity and, hence, in the size of their operand fields. But the same hard-wired machinery that allows the 8088 to decode and carry out instructions enables it to update the instruction pointer correctly after each instruction, so that it always points to commands and never to data.

It is possible for the instruction pointer to get off track, so that it points at data instead of instructions, but with normal operation of finished, debugged programs, this shouldn't happen.

In the early days, when computers were room-filling devices less powerful than your pc, people wrote programs without the benefit of programming languages. That means they entered binary information—instructions and data—into the machine bit by bit.

Needless to say, this was an arduous, error-prone job. Quite apart from the fact that it's difficult for humans to think in terms of binary numbers (or, for that matter, in terms of octal or hexadecimal numbers—which are numbering systems that simplify the notation of binary numbers), the programmer who programmed by hand in this fashion had to keep track of where everything was in memory at all times. Making minor changes to a program, once it had been finished, could be at times as arduous as creating the original, because (among other problems) many of the memory addresses used as arguments for commands would have to be recalculated.

Assembly Language. Eventually people found ways to write programs that facilitated the writing of other programs. This effort led to the development of assembly language and the higher-level languages, like Fortran and Basic.

Earlier installments of this column have dealt in general with the subject of high-level programming languages. But we haven't said much about assembly language.

Assembly language is a major step up in convenience over barehanded binary pro-

gramming. In assembly language the programmer manipulates each individual machine action, much as he would if he were programming directly in binary code, but the procedure is vastly simpler than direct programming.

To begin with, in assembly language, instructions are specified in the form of mnemonics instead of numbers. Each binary op code is represented by a group of letters—like MOV or XCHG—that symbolizes the function of the code.

Second, the assembly language programmer, unlike his barehanded forebear, does not have to keep track of exactly where everything is held in memory. He can attach labels to specific areas of memory and subsequently make reference to the labels, rather than to the memory addresses themselves. This capability is especially valuable when programs are revised; the programmer can make a single change—to the section of code where the label is introduced—instead of having to revise every reference to the affected address.

Third, an assembly language program can be provided with comments, so that long after a program has been written the programmer (or someone else) can still look at the code and understand what's going on. Without comments it would be next to impossible to revise a complex program.

Programming in assembly language is essentially a two-step process. First you write what's called a *source code*, which includes your instructions, label definitions, and comments. Second, another program, called an *assembler*, translates your source code into something the computer can read and execute; that something is usually known as *object code*. If the program is complex, it may require, as a third step, that separately assembled modules to object code be linked; this step is carried out by a program called a *linker*.

If assembly language source listings have to be converted into executable object code by a separate program, an assembler, then how is an assembler written? Usually, although not necessarily, by another assembler. The earliest assemblers, of course, were created by direct binary programming.

For a small sample of what assembly language source code looks like, see John Socha's program to fix the ROM printer bug on the pc; that program is listed on page 41 of this issue. If that block of code looks to you a trifle arcane, don't feel too all alone; most people would agree that assembly language programming is more challenging (how's that for a euphemism for *difficult*?) than writing in high-level languages. Nevertheless, you'll have to admit that an assembly source list looks somewhat more intelligible than a stream of binary numbers.

Why do people program in assembly language, if high-level languages are easier? For either or both of two principal reasons.

Assembly language programs almost always run faster than equivalent high-level code. They certainly run faster than comparable programs written in interpreted languages, such as Basic and p-System Pascal. They also generally perform better than programs written in compiled high-level languages. Compilers are general-purpose tools that sacrifice efficiency somewhat for the sake of generality; the assembly language programmer, by specifying and controlling each machine-level action, can create more compact and more efficient code than most compilers can.

Second, assembly language provides the programmer access to the fundamental operating routines of the machine. The business of Socha's Printfix program, for example, is simply outside the scope of a language like Basic. You could do the equivalent of that program in Basic, but you would have to do it by means of Basic's *poke* statement, which allows you to manipulate directly the contents of specific memory addresses. Doing the job that way is almost as primitive as direct binary programming (the principal difference being that Basic allows you to use decimal numbers).

For maximum speed or for gut-level manipulation of the computer, assembly language is still the medium of choice. ▲

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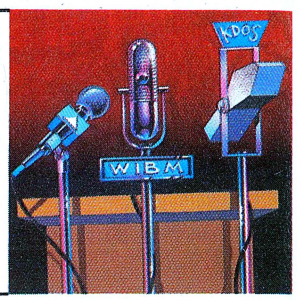

Unless otherwise indicated, software listed runs in DOS on machines with either display adapter and requires 64K and at least one disk drive.

Δ **Correction:** *The Guide to Personal Computer Offerings from IBM* is available at all authorized IBM Personal Computer dealers, and not directly from IBM, as was stated in the January issue.

Δ A five-year bestseller has been released in a second edition, *Basic Programming Primer*, published by **Howard W. Sams and Company** (4300 West 62nd Street, Box 7092, Indianapolis, IN 46206; 317-298-5400). Contains a new chapter on coding and error checking, three fully documented game programs, and newly added statements, key words, and commands. $17.95.

Δ **California Computer Systems** (250 Caribbean Drive, Sunnyvale, CA 94086; 408-734-5811) has announced a Z-80 processor board that makes CP/M 2.2 and CP/M 3.0 programs accessible. Board has 192K memory. $325. Δ A video interface board will give you dramatic gains in graphics capabilities on the monochrome monitor. $695. Δ Compatible graphics adapters available. $99 and $249.

Δ *Videogram* is a sixteen-color graphics presentation package that creates customized color graphs for 35mm slide shows. Can also be used to paint color scenes for displays, design color data-entry forms, draw complex images for video-based animation, and teach computer graphics. From **Softel** (34½ Saint Mark's Place, New York, NY 10003; 212-677-6599). Requires Plantronics Colorplus board and RGB monitor. $300.

Δ **IBM** (Box 1328, Boca Raton, FL 33432; 305-998-2000) now offers a thirteen-inch color monitor for the pc. $680. Δ A Binary Synchronous Communications Adapter has also been announced. The adapter links the pc to host systems or other pcs via switched or leased line networks using BSC protocols. Operates at up to 9,600 bits per second. $300. Δ Related software, *Binary Synchronous Emulation*, allows the pc to act as a BSC 3270 terminal. Requires 128K. $700. Δ A *UCSD p-System Runtime Support* package runs applications written for p-System IV.03, including Fortran-77 and p-System Basic. Comes with formatting and copying utilities. $50. Δ The *IBM Personal Computer Professional Editor* is a full-function, full-screen editor. $130. Δ *IBM Personal Computer Strategy Games* is a set of four popular board games: *Checkers for Beginners, Reversi, Battleship*, and *Elusion*. Color/graphics adapter required. $30.

Δ *Sapana Household Track I* keeps track of household goods. Catalog price, where purchased, current value, room, and location of object in room. From **Sapana Micro Software** (1305 South Rouse, Pittsburg, KS 66762; 316-231-5023). $49.95. Δ *Sapana Soft Index* keeps track of published information, including articles, books, magazines, and newspapers. Catalog title, author, topic, page number of article, and so on. $49.95.

Δ The accounting software system from **Small Business Systems Group** (6 Carlisle Road, Westford, MA 01886; 617-692-3800) includes general ledger, accounts payable, accounts receivable, payroll, invoicing, and inventory. Modules can be used separately or be combined. Designed to run in CP/M-86, MP/M-86, CP/M, and MP/M. $450 per module.

Δ *Retail Computer and Software Store Profiles* is a series of reports that are tailored to your specific needs and updated three times a year as a marketing tool by **Computer Intelligence** (3344 North Torrey Pines Court, La Jolla, CA 92037; 619-450-1667). Initial fee: $250; $100 per month.

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Δ The *IBM/PC Guide* is a combination book and disk tutorial for persons with no prior knowledge of personal computers. Fundamental computer concepts and programming skills, operating system, text editing, music, and sound generation are some of the topics in the eleven-chapter guide. On the disk: a sketch pad that generates bar graphs, calculator, model program, and more. Published by **Banbury Books** (37 West Avenue, Wayne, PA 19087; 215-964-9101). $29.95.

Δ A business card organizer called *B.C.* from **Specific Software**

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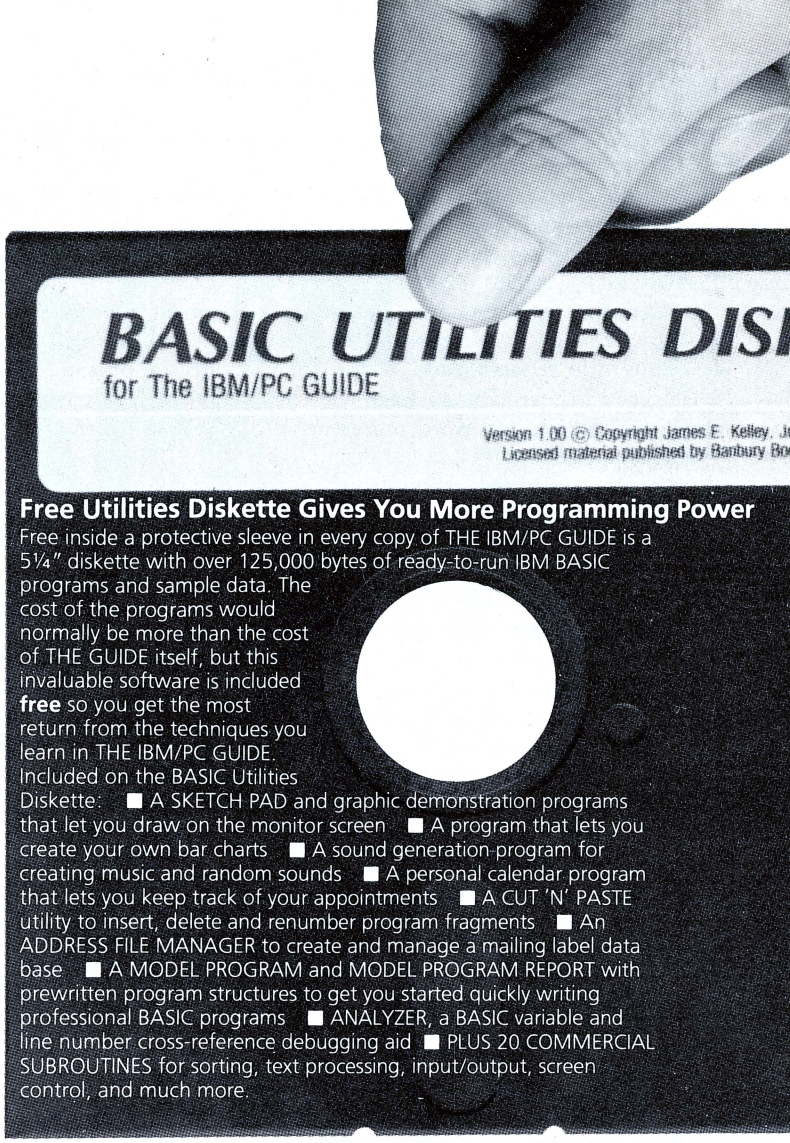

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Δ *The Name and Address List Management System* manages lists, prints listings and labels, and has five choices of print selection (state, area code, zip, and so on). From **M&J Automation** (Box 205, Plainsboro, NJ 08536). $29.95.

Δ A Canadian software house, **Business Development International** (Box 5, Station A, Winnipeg, Manitoba, Canada R3K 1Z9; 204-837-8509) has released *Form Writer*, for use with the pc and the Diablo 630 Printer. The package is a combination database manager, mail merge, and word processor, all on one disk. Sends at 9,600 baud. $275.

Δ A graphics-oriented, menu-driven project-scheduling package, *MicroPERT*, has been announced by **Sheppard Software** (4750 Clough Creek Road, Redding, CA 96002; 916-222-1553). Time-scaled graphics outputs from the package include Network Diagrams and Gantt Charts. Projects containing 220 events and 220 projects can be scheduled in twenty seconds or less. Requires 128K and two 320K disk drives. $750.

Δ The ability to host mainframe data files, SNA networks, and hard disk storage capacity through the company's SyFA Network Processors has been introduced by **Computer Automation** (2181 Dupont Drive, Irvine, CA 92713; 714-833-8830). *CASyFA* software allows pc users tied into a SyFA network to participate as functional SyFA work stations, with interactive access to all system functions, features, and data files. SyFA Network Processors are designed for DDP applications ranging from a low-cost data entry system to a powerful multiterminal, multinetwork cluster controller. Additional function key emulation is provided to use the pc as an IBM 3270 work station in conjunction with 3270 emulation software.

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Δ Interface with mainframes using appropriate software with *PowerBase*, an easy-to-use relational database management system from **GMS Systems** (12 West 37th Street, New York, NY 10018; 212-947-3590). Features fast search, sort, and select, search keys for "sound-alike" retrieval, and the capability to handle arithmetic expressions written in algebraic form. Also automatically recalculates derived data fields whenever a base data field changes. DataZoom feature can "explode information up to sixteen levels deep," showing detailed components. Includes several ready-to-run applications; requires 128K and two disk drives. $475.

Δ **Systemics** (3050 Spring, West Bloomfield, MI 48033; 313-851-2504) has added *EZEntry* to its line of small business and personal software. The invoicing and on-screen order entry program requires two disk drives. $99.95.

Δ Play the risky commodities market with *Tycoon*, a strategic simulation that includes trading of futures contracts in gold, soybeans, U.S. Treasury bills, foreign currency, pork bellies, and other popular commodities. A painless and risk-free learning experience from **Blue Chip Software** (19824 Ventura Boulevard, Suite 125, Woodland Hills, CA 91364; 213-881-8288). $99.95.

Δ *Graphics Utility* can serve as a standalone graphics generator or be used to display various character sets and shapes from a Basic program. Shapes are created and edited on a large grid, with the actual shape displayed on the side. Create different sizes and fonts for special character sets; create shapes for animation; combine shapes and save as one. Requires color/graphics adapter. $55. Δ *OptionCalc* calculates the theoretical values for put and call options according to the model of Black and Scholes. Enter information of the option and the underlying stock, and the program calculates the value, exact expiration date, number of days to expiration, the hedge ratio, and the put and call symbols. Do "what-if" analysis without reentering data. Requires color/graphics adapter. $65. Both from **Savant Software** (Box 42888, Suite 164, Houston, TX 77042; 713-556-8363).

Δ Save money on both federal taxes and tax preparation with *TaxCut* from **United Micro Systems** (100 North Stone, Suite 1100, Tucson, AZ 85702; 602-622-4751). Test the outcome of hundreds of tax-related alternatives; make decisions on IRAs, Keogh plans, and investment in business equipment; project figures for income averaging, installment sales, investment credit, and more. Includes twelve-month subscription to *TaxTips*. $250.

Δ **Sawhney Software** (888 Seventh Avenue, New York, NY 10106; 212-541-8020) announces *Taxmode*, a tax planning system for individual income taxes. Computes federal income taxes for 1982 or later and includes the provisions of TEFRA of 1982 and inflation indexing beginning in 1985. Results displayed continuously; several alternatives can be displayed while you do the planning. Major IRS forms included. Requires 96K. $299.95.

Δ *The IBM Personal Computer Handbook* is in production at **And/Or Press** (Box 2246, Department PC, Berkeley, CA 94702; 415-849-2665). Applications covered are word processing, financial analysis, databases, and networking; special emphasis on business; software development is explained. $19.95. Hardcover: $29.95.

Δ Insert your disk and *Libby* scans the directory, generates a sorted master file, and saves the file. From **Advanced PC Systems** (608 Lisa Way, Campbell, CA 95008; 408-243-1925), the automatic library management program catalogs files and programs all on one master disk. Prints file report; can be updated. $49.95.

Δ **Theta Business Systems**'s (1110 Sonora Avenue, Suite 106, Glendale, CA 91201; 213-245-0917) five-module Pascal business package includes accounts payable and receivable, general ledger, payroll accounting, and order entry. General ledger has three levels of input built in: clerk, accountant, and executive. Set of twenty-five utilities included. $2,000 per module.

Δ **Avacado Computer** (Box 632, Yorba Linda, CA 92686; 714-528-1025) makes an adapter for the color/graphics card that adapts all

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color software to monochrome monitors, allowing green-screen monitors to deliver sparkling displays. The PC16G adapter generates a sixteen-level gray scale; installs easily on the RGB connector. $89.99.

Δ Report #1506, *IBM's Personal Computer Strategy—The Next Round*, is available from the research and consulting organization, **Strategic Incorporated** (Box 9747, San Jose, CA 95157; 408-243-8121). Projections in the report include IBM's response to Apple's Lisa, the introduction of a Unix-type operating system, the marketing of hi-res color graphics and/or mouse capabilities, and more. $1,500.

Δ A system of *VisiCalc* financial templates to assist the manager of service firms in such fields as engineering, advertising, architecture, and consulting has been announced by **Pro/Pac** (14925 Memorial Drive, Suite 106, Houston, TX 77079; 713-496-1179). *Financial Management Models for the Service Firm* will determine billing rates, estimate fees, forecast cash needs, budget projects, determine staff assignments, and more. Requires *VisiCalc*. $295.

Δ *Flip-Ello* is played according to the rules of the popular board game *Othello*. Play against the computer or another human opponent, switch sides with your pc at any point in the game. From **Resuba Digital Systems** (Box 440, Department 9, Blackwood, NJ 08012; 609-228-5666). $12.50.

Δ **Small Business Systems** (1016 31st Street, La Grange Park, IL 60525; 312-579-3311) makes an integrated general accounting system that includes general ledger, accounts receivable and payable, order entry with billing, inventory control, and sales analysis. Compatible with CP/M-80 and CP/M-86. $950 per module. Δ *The Pascal Development System* is for programmers developing commercial software written in Pascal. $950.

Δ The Wizard-EBI Epson Buffered Interface allows you to dump print data into the buffer without changing printer characteristics. No special software or cabling required; buffer is available with 8K to 64K. From **Wesper Microsystems** (14321 New Myford Road, Tustin, CA 92680; 714-730-6250). $139 to $280.

Δ A texture-finished steel security unit for the system unit with a storage drawer for the keyboard, called Computer Escort, is available from **FMJ** (Box 5281, Torrance, CA 90510; 213-325-1900). A removable adhesion plate secures the unit to a table top or desk. Also room for cable storage and optional transient suppression unit. $155.

Δ A multifunction RAM board is available from **Anatron** (202 West Bennett, Saline, MI 48176; 313-429-2678). AnswerRAM features a unique multiple I/O port design. Software for electronic disk application and print spooling included. $595.

Δ **Automation Consultants International** (18070 Lake Encino Drive, Encino, CA 91316; 213-344-9270) has introduced *CataList*, a cataloguing, list and file management, and maintenance package. Can be used for inventory control, vehicle maintenance, and insurance record keeping, as well as household inventory. Eighteen fields per category; handles foreign addresses and new nine-digit zip codes. Requires two disk drives. $200.

Δ *Graph 'n' Calc* is a hi-res business graphics system with an advanced calculation facility. Provides advanced statistical and financial functions that standard spreadsheets don't have; creates bar, stacked bar, and pie charts from Visi series or *Desktop Plan* modeling software. Can be presented in slide show format or printed. From **Desktop Computer Software** (303 Potrero Street, Suite 29, Santa Cruz, CA 95060; 408-458-9095). $199.95.

Δ *Accounting Plus* is now available in CP/M-86 and PC-DOS, according to **Software Dimensions** (6371 Auburn Boulevard, Citrus Heights, CA 95610; 916-722-8000). The comprehensive accounting system collects, organizes, and processes financial data in a package of eight modules, including general ledger, accounts payable and receivable, sales and purchase orders, and inventory control. $495 per module.

Δ **Daystar Systems** (10511 Church Road, Suite L, Dallas, TX 75238; 214-341-8136) introduces *UltraFast*, a flexible disk RAM emulator that allows a portion of the pc's memory to emulate up to four disk drives. Average seek time is fifteen hundred times faster; data transfer is six times faster. No patches to PC-DOS required; parity handler included; emulates disk sizes from 8K to 320K per drive. $39.95.

Δ A complete system for managers of apartment buildings has been released by **User-Friendly Software** (Box 1192, Melville, NY 11747). *The Apartment House Manager* can determine status of each apartment and tenant on file, keep a journal of rents and expenses, and review a monthly profit-and-loss statement. Prints rent rolls, notices, and leases. $395.

Δ *Mail-Com* enables a company or individual to send U.S. mail from a pc, using the U.S. Postal Service's new electronic computer-originated mail service, E-COM. Transmit mail from home or office; charge others for the service. The E-COM service prints each letter on quality paper and inserts it into a special envelope. Two-day delivery is guaranteed; price is twenty-six cents per page. Requires modem. From **Digisoft Computers** (1501 Third Avenue, New York, NY 10028; 212-734-3875). $195.

Δ *Lazer Maze* is an arcade game that puts you in an arena of angular mirrors. Object of the game is to fire your laser and predict where the beam will reflect. If you're correct, you have defeated your enemy. Requires color/graphics adapter. $29.95. Δ *Federation* is a lightning-fast arcade game that puts you at the command controls of a starship. Your mission: wipe out the invading Drorn Drones that have taken over a mining colony. Requires color/graphics adapter. $29.95. All from **Avant-Garde Creations** (Box 30160, Eugene, OR 97403; 503-345-3043). ▲

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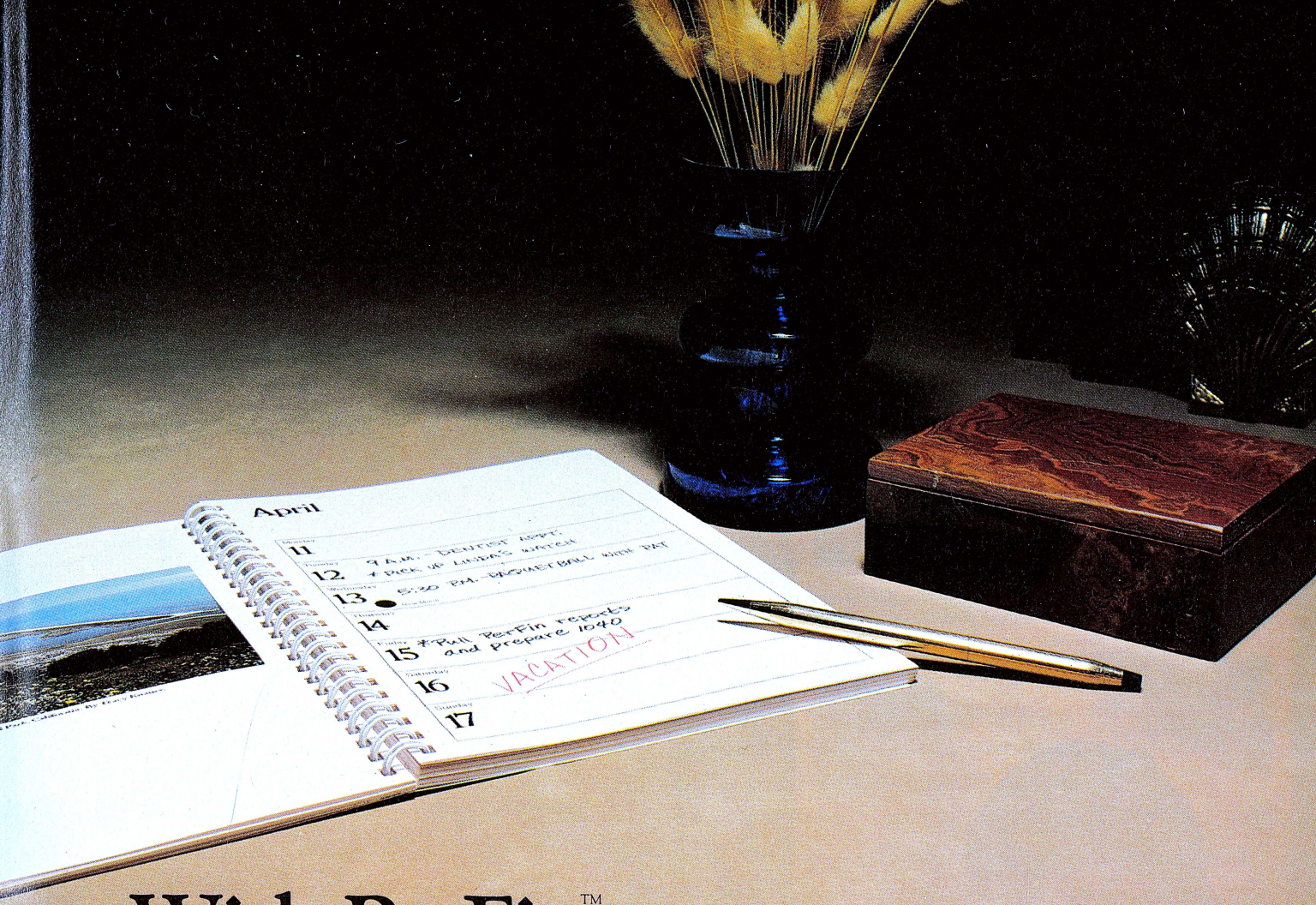

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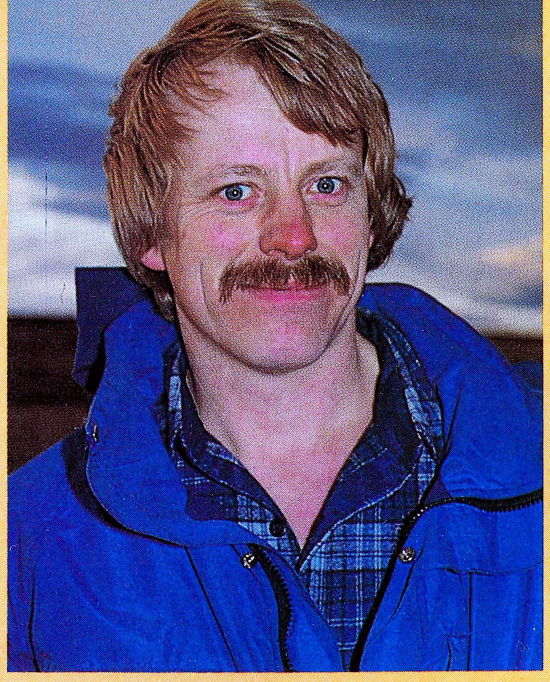
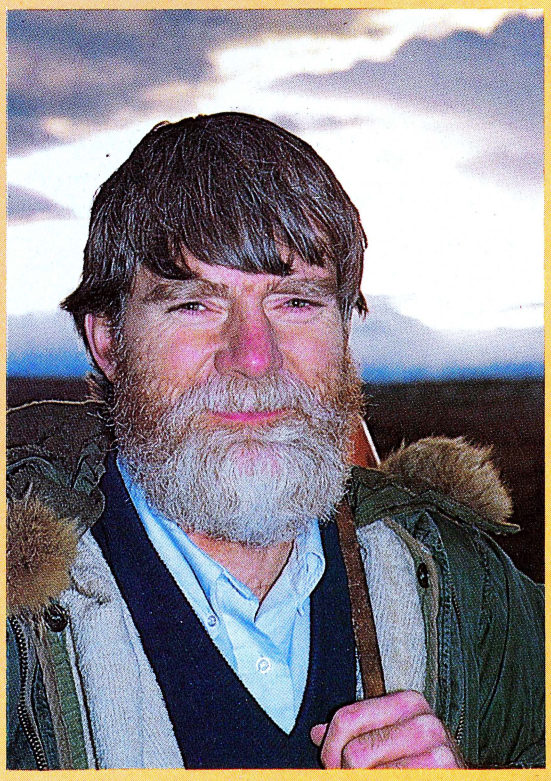


Programmer Dale Johnson (above), surveyor Don Bedard, and an IBM pc work together to prospect the Stillwater Complex.



BIG

by Michael Ferris

Grizzly bears! Blisters! Boondoggles! Computers!

This is the stuff tall tales are made of in the big sky country of Montana, where the geologist and the surveyor still roam.

A big, beautiful hunk of the West that's shot with precious metals, ripe with history, and littered with dinosaur bones, Montana is also a place where new frontiers are being blazed by a Personal Computer.

The state was once described as "bounded on the west by the Japan Current, on the north by the aurora borealis, on the south by Price's Army, and on the east by the Day of Judgment," and was believed to hold more riches than "Indostan, Malabar, or the golden coast of Guinea."

It's the same epic wilderness immortalized in the rugged oil paintings of cowboy artist Charles Russell. Much of it remains unchanged.

Two-fifths of the state is a wonderland of geological oddities that peak at the Continental Divide, the spine of the Rockies. It's a land of shining mountains gleaming with glaciers and teeming with wildlife. The remainder of the land is rolling prairie punctuated by huge, weathered buttes.

Technologically, Montana is a paradox. Well into the 1920s, any place two roads crossed was called a town. The countryside is still a thriving wilderness; exploited, yes, but barely civilized.

An ideal frontier for the pc.

When a geologist in Montana talks of drilling holes as data points and extracting information from the earth, can an electronic database be far away? Computers have a way of nudging everybody into the future.

You are on top of a mountain. There is a stake in the ground.

Command: Get stake.

SKY COMPUTING

You can't have the stake.
Command: Get number off stake.
You have the number.
Command: It will take me four hours to find it!
Do you need help?
Command: Help!
You are at the keyboard of an IBM Personal Computer . . .

"We were swimming in a sea of information," says programmer Dale Johnson of Stillwater PGM Resources, a geological exploration company in Billings. The overload of data provoked Johnson to bring the adventure of personal computing to the paper-packed world of geology in big sky country.

"Geologists would be walking around in the field chipping rocks. When they found a bit of geology, they'd call in, wanting to tie it into the nearest survey point. The markers may have faded, the

numbers are not clear. We might have to go through ten years of files, year by year, to find the right coordinates. A very error-prone process. It could take hours to find one point."

That was how it was in geology, b.c.—before computers. "Now they just tell us the name of the claim they found the geology in and we have the pc dump out all the points held within that claim," says Johnson.

Captain Computer. He's called Captain Computer by some of the gang at the office. At home, consulting with his Apple, he's also known as Absarokee Software.

Johnson sits ensconced in his technological cocoon at the PGM Resources office, amidst the rocks, maps, charts, field books, and file folders that threatened to drown the company's ongoing project—geological exploration of the Stillwater Complex, a roughly five-by-twenty-eight-mile streak of rock laced with strategic metals high in Montana's Bear Tooth Mountains.

The company, a joint venture of Manville Products and Chevron USA, is exploring the mountains for platinum and palladium, two rare elements second in value only to gold—and once worth even more. The area's mineralized zone promises to be as rich as the Merensky Reef in South Africa's Bushveld Complex, the world's primary source of the siren metals.

Ninety-five percent of the world's output of strategic metals, including chromium and cobalt, now comes from Russia and South Africa. There is little production in the United States, a fact that gives a double edge to the word *strategic*.

Platinum and palladium are used strategically in the petroleum, auto, and electrical industries; they're vital to catalytic converters, unleaded gasoline, and voltage regulators. As good as gold and cheaper, palladium alloys may replace acid hard gold in the production of connectors and printed circuits.

Johnson claims his computer work is only a small part of the whole Stillwater project: geology is the main thrust. But, as computer literati will tell you, get one computer in the door and you're living better electronically, whether you know it or not. Computers aren't shy about revolutionizing; it's the programmers who don't want to brag.

But wherever the company's exploration process has exposed a need for some special programming, Johnson has written it. There are plenty of calls for Captain Computer throughout the company, and he paces his programming now. Meanwhile, he juggles his keyboard skills with his engineering skills; he's also busy drafting an access road to the Complex site.

A massive computer database with detailed information of over five thousand different survey and grid points is Johnson's ongoing project. So far, a thousand points have been entered into the pc version of the surveyor's file cabinet, using *PD Base*. Fields of information entered are station name, or identifier of survey point; coordinates of location; northing, easting, and elevation (comparable to x, y, and z axes); year of survey; field book number and page; how it was located; and type of survey monument.

Claim names like Blitz, Tecate, Tusker, and Labatts may sound familiar to beer connoisseurs; senior geologist Doug Keith is a collector of rare brew bottles. Dinkel Acker and Tsingtao are future claim names.

"The database tells us what we've done over the last year as far as surveying goes," says Johnson. "It lets us know which claims have valid discoveries, where we have problem areas, and so on." All part of what goes into the annual report, now processed courtesy of *WordStar*.

Big Claims. Since 1968, the company has established twenty-two hundred millsite and lode claims at the Complex. A lode claim is a rectangle of land fifteen hundred feet long and six hundred feet wide. A map of the Complex showing the claims looks like a crowded cluster of domino shapes snaking across the terrain.

In addition to claims, company surveyors stake out an extensive grid of the area, with tagged wooden stakes every one to two hundred feet, so geologists can keep tight control on ore-body location.

Physically determining these points on the map is the work of the in-house survey team, headed by Don Bedard, who has been with the project since 1980. A licensed surveyor for seven years, Bedard learned his trade from college and Army survey school.

Surveyors, who work hand in glove with geologists in the field, are called in when geologists and drillers strike some promising ore. "Then we come in and slap a bunch of claims on top of the mineral deposits, giving notice to everyone and the federal government that we've found something," Bedard explains. First, claims are put in rough. "We just go in and plop down some corners. Then we come back and locate them more accurately." Surveyors, staking a rough claim, can use a rock or a tree notched on four sides, as well as a wooden post. Then government surveyors "monument" the four corners of the claim with brass markers.

The Stillwater Complex is on Forest Service land, a section of the nation's public lands open for development. Making a claim is the first step in securing the patent on the surface rights of the land. Any previous claims are on file with the Bureau of Land Management and must be researched.

A claim for gold or copper was filed in the 1890s, says Bedard. "It has always been suspected there might be some gold at the Complex. There were traces of it in the water samples, but nobody has really been able to pin down where it was coming from."

During the war years of the forties, Stillwater was a strategic site for three chromium mines, the Gish (named for the film star), the Mouat, and the Benbow. About the same time, the U.S. Geological Survey mapped the area, interested in its unusual rock assemblage.

Montana's mineral wealth has been well surveyed. The state even has a notorious surveying folk hero, Fritz Augustus Heinze. In 1895, Heinze took advantage of the Law of the Apex, a federal statute that permits claim owners to follow down any vein of ore surfacing on their property. Heinze discovered, claimed, and surveyed a tiny triangle of land and announced that three major mines—the Apex, the Saint Lawrence, and the Neversweat—apexed on it. While he bare-knuckled the copper kings in court for eight years, the industrious poacher dug millions from the three mines.

A Bear for Lunch. While acknowledging the pressure of meeting the geologists' demands, Bedard is invigorated by the challenge of working outdoors most of the year, despite the hazards of rough terrain, mosquitoes, nosy elk, moose, and deer, and hungry black or brown bears. "One guy heard some noise back where his pack was one day. He turned around and there was a bear eating his lunch. Some claim to have seen grizzly tracks at the Complex, but if they were up there we'd have seen them by now."

The precision staking of a claim in the field is where the art of surveying gets a real workout. The tools of the surveyor are a theodolite, a thirty-power telescope on a tripod; a finely cut prism mounted on a range pole crossed with a level; and an electronic distance meter (EDM), a machine that measures light waves bounced off the prism. Bedard logs the information into field books.

"Shooting arrows out," or radial surveying, is how the Stillwater claims are located by Bedard and crew. "We would set up a triangulation station on a high spot and send a bunch of prisms out into the field. If the range poles are too far away we have to put color on them, like fluorescent orange. I get a bead on a prism through the theodolite's crosshairs, center exactly on it, and record the angle. Then we use the EDM to get the distance. After that, it's a matter of trigonometry—refining those measurements down to degrees, minutes, and seconds to get the shape we need."

If the forestation is too dense, surveyors trudge through the brush with a linked traverse chain marked for distance, like the rope

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stretchers of ancient Egypt who created the art.

Johnson has written a radial survey program for the pc that computes all the data gathered from field book notes before the points are entered into the main database.

The gray-marbled geology of the Stillwater Complex is unusual because the rocks that host the platinum/palladium ore are stratified igneous rocks, which seldom are layered like sedimentary deposits. It's also only the second place on Earth at which economic deposits of these metals have been found. One theory has it that the Complex, including the thin band of metals paralleling the host rock, is the result of the action of molten rock billions of years ago that never reached the surface. The rock layers have been tilted over time—from near horizontal to angles ranging from forty-five to ninety degrees.

The exposed edge of the mineral layer is a scant five to fifteen feet wide and runs about twenty-eight miles in length. Nobody knows how far down it goes. "It hasn't bottomed out yet," says Carleen Holloway, one of six geologists on the project.

So far, the geologists have drilled down to about seventeen hundred feet below the surface. "Now we've got to find out what happens at two to three thousand feet, the level where the tunnel to mine the ore will actually be dug," she says.

This subterranean exploration requires drilling into the steeply dipping ore zone at a cross angle to take core samples. Small, portable Winkie drills are used for the shallower data points, two to three hundred feet deep. Larger drills, called Longyears, are used for deeper samples. "The drilling is a hot, dusty, crummy job," Holloway says. "Drillers have to keep the things lubricated, keep them moving, and not jam the rod."

Longyears are hefty drills that must be flown up the mountains slung under a fourteen-passenger Bell 212 helicopter and assembled on the site. They must also be choppered from hole to hole. "Winkie drills can be carted on somebody's back," says Holloway.

The time necessary to drill a core sample varies with the ground condition. "In an area of very competent rock, they can go one hundred feet a day, no problem. In an area where you're constantly fighting faults and constantly losing water that seeps into the countryside, you can maybe get two feet a day," she explains.

Minerals by Modem. Core samples are sawed into pieces and sent to Vancouver, B.C., for geochemical analysis. Turnaround time for mail to Canada is about two and a half weeks. "We had such a poor mail turnaround time," says Johnson, "that we decided to get a Smartmodem and go with electronic mail. Now we download the results off the Boeing computer network. A few days after the sample is analyzed, we have a computer printout of the metal content." A minicomputer in Vancouver transmits the data to the Boeing network.

Geology can be blistering work. The terrain of the Stillwater Complex is rugged, with a lot of tree cover. Elevation is six to ten thousand feet, some of it above snow line. "It's steep country; we've got a lot of relief. In our work we're going up and down hills all day," says Holloway, who finds the Complex fascinating and a choice area to work in. "There are places where we really need information that we just don't have, where there are no outcroppings of the ore zone. We have to do a lot of interpolation between points."

The ever-enterprising Johnson has found a way to do this hunch work by computer. He's written a three-point stratigraphic-problem routine that intersects three drilling points, trigonometrically calculates the direction and dip of the ore plane, then fills in the blanks by giving the intersection of the ore.

Working in an area where faults run rampant and have shifted the platinum reef up to several hundred feet, a geologist is often only as good as his or her best guess. "You hope everything important gets covered. We can plan the next summer's work during the winter, but there are a lot of variables in our ore zone," says Holloway.

The geologists—young, highly educated, intelligent, and environmentally aware—take these kinds of variables in stride. "They're good people to work with," says Bedard. "They're very outspoken, not a lot of BS. They give it to you straight. Of course, a few haven't hit it off in our camp, but it's not easy living and eating together for ten days at a time. Most of them are relaxed, easygoing, and really know what they're doing."

Environmental awareness is a complex part of the job for geologists today. Montana is a casebook of the "get in and get out" philosophy that once ruthlessly exploited the state's natural resources. In the 1800s, copper industrialists controlled Montana's legislature, secretly governing to suit themselves the land they exploited. The beaver, the Indian, and the buffalo were almost wiped off the map in the last century. The beaver was only saved from extinction by a change in fashion.

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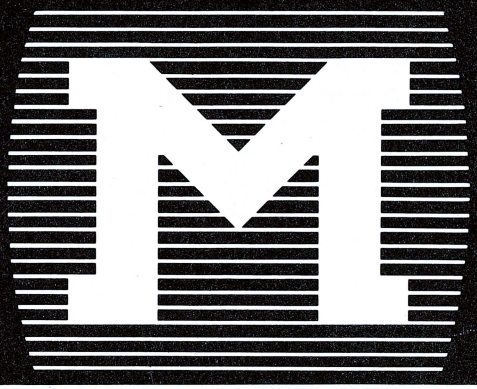

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Nowadays, there are environmental impact reports, archeological studies, forest service reports, reclamation bonds, and a general attitude of "let's be careful out there."

The archeological study done at the Stillwater Complex turned up some Indian vision-quest structures, slightly troughed collections of rock, resembling beds, where Indians meditated. Several buffalo jumps were found, too, where Indian hunters would run the animals off a cliff. Otherwise, the area has been okayed for developmental operations. Drill sites have been approved and individually bonded for reclamation. Grazing animals, it turns out, are loyal consumers of fescue, a type of reclamation grass.

The geologists' and surveyors' work at PGM Resources is seasonal; they get one shot a year. Maps and charts for future in-house use have to be ready by spring. "We spend the summer in the field collecting, working out of a base camp and getting choppered up to the site each day," Holloway explains. "In December, when you figure you should have checked something out, it's too late. When these things occur to you in the field, you just go for it.

"Our work is a combination of drilling, mapping, and making an informed guess. Year after year we build on our knowledge." She picks up a chunk of rock to show the streak of metals in it. "We've proved the metals are there. Exploration has refined the location and continuity of the ore zone. Now we're officially in the development phase, looking for the best place to put a mine. Since the platinum/palladium occurs as microscopic specks in fractions of an ounce per ton, we now have to determine how best to extract and then concentrate the ore."

Information gathered in the field from drilling and interpolations is charted on a four-foot-long graph, ragged bands of color and texture representing layers of rock. The platinum/palladium ore zone is shown as a thin red line. This stratigraphic fence diagram eventually will be done on the pc, says Johnson. Drill-point data will be entered and a brightly banded chart printed out.

Before he ventures into graphics, Johnson will have to add a plotter to his configuration. He already has 320K of memory in his machine, "and I use it all the time. The p-System uses it as a third disk drive." He's a fan of the p-System because of its portability.

Basically self-taught in Pascal, Johnson is hooked on the structure of the language. "It's much easier to write complex programs in Pascal. The math portions of our work are quite complex, mostly trigonometry and geometry, with very involved subroutines."

It was a long, hard fight to get the computer into the office at PGM, says Johnson. "I don't think they realized the mass of information needed to do the job. The first thing I did when I was hired was write a report on why we needed a computer."

The geologists and others at the office didn't have to be convinced. Frequent all-night adventure sessions with *Zork II* and a rack of high scores in arcades attest to the micro's popularity.

Like everyone, Johnson complains about the placement of the cap and control keys on the IBM keyboard, but that's about all. The usually unflappable programmer goes blank when asked how the pc has held up on the job. He checks around to see whether anyone remembers if anything ever went wrong. The story of a disk crash brings a few hearty laughs, but Johnson says, "It wasn't humorous at the time." Four hours' work with a utility disk reclaimed access to the precious database.

He does have one heroic computer tale to tell, however. "We had the pc in an office trailer last summer, on a ranch up near the site. It sat right next to a helipad, quite a dusty environment. Every time a helicopter landed, dust rolled all over. I expected some power supply problems, too. Up there, it's the end of the power lines, the phone lines, everything. With the sun beating down, it got up to the nineties inside the trailer; in the morning it was in the twenties.

"There were no problems," shrugs Johnson. "How can you be dissatisfied after a performance like that?"

The pc passed its field test with flying colors, earning itself a cushy desk job at Stillwater PGM Resources, working in the mineral frontier of Montana. ▲

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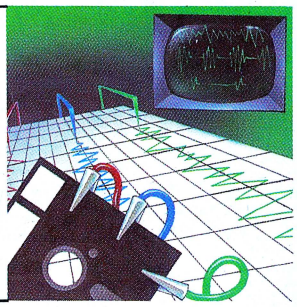

Unless otherwise indicated, software reviewed runs in DOS on machines with either display adapter and requires 64K and at least one disk drive.

PC-Man. By Greg J. Kuperberg. NBC sportscaster Dick Enberg has won the highest awards in the broadcasting profession by using "Oh, my!" as his trademark expression of high praise. Whenever the action captured on-screen is so extraordinary that the usual superlatives fall short, Enberg says, "Oh, my!" and lets the instant replay do the talking.

Finally, we've got an arcade program that deserves an "Oh, my!" on the pc. It's *PC-Man*, and if the name doesn't give you a hint about the program's content, you've been hibernating for the past two years.

PC-Man is a maze-chase eat-'em-up. There's nothing too special about that. Every personal computer worth its salt, except the Timex, has several versions. What's special about *PC-Man* is that it's absolutely the best rendition of this genre on any microcomputer to date. It's better than anything on the Apple. It's better than *Pac-Man* on the Atari. George Plimpton would no more compare Intellivision to *PC-Man* than he would compare the Timex 1000 to an IBM System 38.

In fact, *PC-Man* is so good, its areas of deficiency would be considered strong points on almost every other entertainment package so far introduced into the pc marketplace. For example, the use of color is not exceptional, especially in light of what's being done on other micros. But only *Microsoft Flight Simulator* has better color on the pc. A joystick used with the game was alternately mushy and balky yet still was more responsive than on some other games available.

There's only one area where the program might be improved. That's the collision counter. For those of you not versed in the arcane rites of arcade games, the collision counter determines whether two items on a collision course do, in fact, collide or miss. Devising accurate collision counters is a far truer test of a programmer's skill than providing color or smooth animation, and *PC-Man*'s algorithm in this regard is better than most.

Even with that statement on record, there's a strong desire to strangle the author every time you race for a power dot, only to be eaten by a micromonster who got there at the same time you did. Fair is fair, Mr. Kuperberg. When it's man against machine, man doesn't deserve unfair advantage, but he should at least get the benefit of ties. Especially at the power dots.

PC-Man comes to us from the unlikely locale of Auburn, Alabama. The Deep South has been the deep sleep during the electronic boom. Some folks down there remain convinced the still is the highest form of technology. But Orion Software and author Kuperberg look like they'll be competitors to reckon with in the pc market and any other market they decide to enter. As Dick Enberg would say . . . art

"Oh, my!"

PC-Man, by Greg J. Kuperberg, Orion Software (Box 2488, Auburn, AL 36830; 205-887-9721). Requires 48K and color/graphics adapter. $34.95.

8087 Drivers. Before we say anything about the Micro Ware drivers, a little background is in order.

The brain of the IBM Personal Computer, the Intel 8088 microprocessor, can do all normal general-purpose computer work, including integer arithmetic. But it can't do floating-point arithmetic except by means of time-consuming subroutines.

Floating-point numbers are known to Basic programmers as *single-precision* and *double-precision*; Fortran refers to them as *float*, and Pascal calls them *real*. Floating-point numbers consist of two parts—a mantissa and an exponent; their format allows them a wide dynamic range, from very large to very small. Usually, floating-point numbers aren't exact; instead they hold approximate values, accurate to some specified degree of precision.

The 8087 was designed to add fast and accurate floating-point capability to the 8088. The two chips together, with appropriate software, have much more computing horsepower than the 8088 alone. The pc contains a socket intended for the 8087, but none of the standard IBM software can make use of the 8087's capabilities.

What are those capabilities like? In a word, they're awesome. There are four impressive aspects of the 8087's power. The first is the part we all know about—fast floating-point arithmetic. How fast? Claims vary widely; the timing test for this review clocked a speed improvement of exactly ten times. In subjective terms, the

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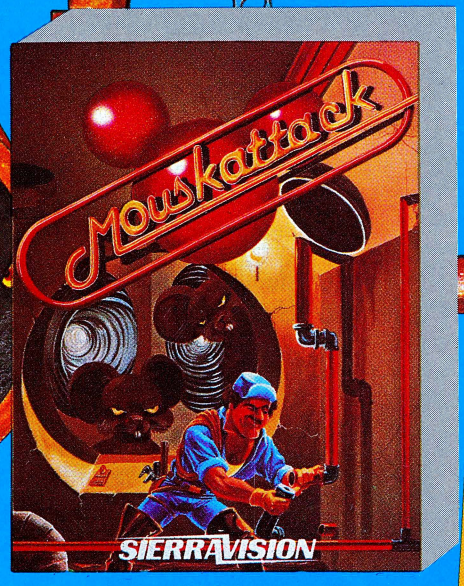

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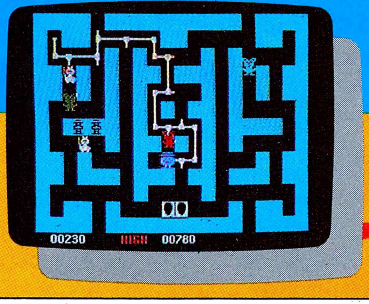

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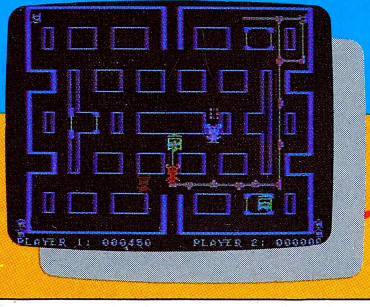

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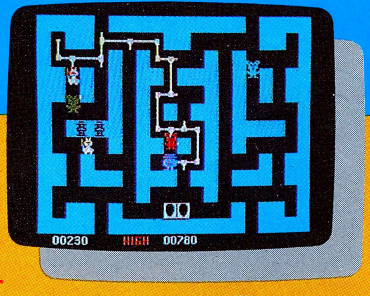

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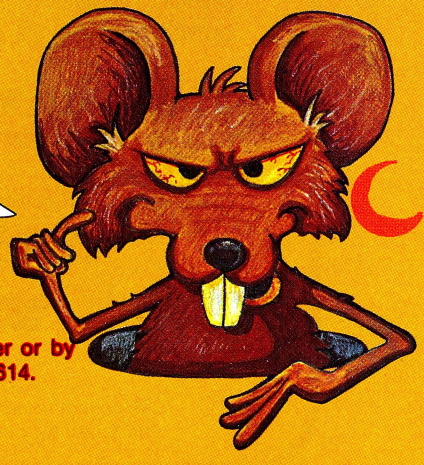

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8087 puts the pc in a computing league with quarter-million-dollar supermini computers. But speed is only part of the 8087's remarkable prowess.

A second aspect is precision. Traditional large computers work with thirty-two or sixty-four bits of data. The 8087 works with eighty-bit words, which give it over nineteen decimal places of precision and a monster-size dynamic range. Even the legendary Cray super computers don't have the 8087's word size.

Extra functionality is the third aspect. The 8087 doesn't just do four-function arithmetic; it also has built into its circuitry logarithmic and trigonometric functions, so that even these transcendental functions don't require lengthy subroutines to calculate. From the user's point of view, this capability is just another part of the 8087's speed; but the idea of these built-in features is stunning. No mainframe computer has them, but with the 8087 your little pc does.

The fourth aspect is a wide variety of data types. The 8087 will work with several sizes of both integers and floating-point numbers. It also accepts a high-precision decimal format, which has interesting possibilities for mundane applications such as accounting programs.

How much of the 8087's abilities will we see realized in the pc? Not too much. The speed obviously will be put to good use. But the super precision will hardly see the light of day. Since most use of the 8087 will be funneled through the data limitations of conventional programming languages (Basic, Fortran), not much benefit will be gained from the 8087's eighty-bit precision. And the decimal capability is sure to wither as an unloved spinster.

What can (and can't) the 8087 do for you? First, without the appropriate conversion software, it can't do anything. And it won't speed up your word processor. It won't speed up anything that isn't doing floating-point work. Obviously, if you're doing traditional scientific and engineering calculations, the 8087 will work wonders for you.

But even if you aren't crunching numbers, you may be more of a floating-point user than you imagine. Many Basic programs use floating point just for convenience; so if you're running much Basic, you might benefit from a conversion to the 8087. And if you are annoyed at the slow speed of your spreadsheet program, consider what an 8087 version might do.

Micro Ware has gone into the 8087 business in a big way. It sells the chip ($223) and a lot of software to put it to work. Anyone can buy 8087 chips from Intel and sell them to you; the question is, what can you get in the way of software? Micro Ware is covering that base in a fairly complete way, with software packs, at $150 each, for four languages (assembler, Basic, Fortran, and Pascal). An 8087 spreadsheet and a C compiler are also in the works. The task they've set themselves is huge, and what they have been able to deliver is impressive. But with such a big job before them, they have sacrificed a lot of the quality we've come to expect in products for the pc.

What they provide for each programming language varies, depending on what is needed. For Fortran it is simply a new compiler subroutine library, with routines to activate the 8087. For Pascal it's a new library and a slightly modified compiler. For compiled Basic it is an interesting module that's linked with your programs. (Basic programs must be compiled in the Basrun mode, and interpreter Basic is out in the cold. Also, Basic programs using the 8087 must do some time-consuming data conversion every time the 8087 is handed any work to do; we've had reports that this cripples the speed advantage, so that Basic programs gain no more than 30 percent in speed.) For assembler, it is a modified assembler and some very interesting and powerful tools, such as a precompiler (which converts 8087 op codes into a form that the *Macro Assembler* will accept), along with a setup for doing Forth-like stack operations in assembler. All in all, very impressive. But.

But the delivery is crummy indeed. You might naturally expect

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Micro Ware's sample programs to demonstrate the speed differences with and without the 8087. They don't; they just illustrate numerical results.

The Basic sample program provided wouldn't run. The Pascal sample had the wrong value for pi and wouldn't compile with the standard compiler. The demonstration sample for the assembler preprocessor demonstrated 237 error messages; also, the preprocessor has some of the worst human engineering you'll ever encounter and leaves your display screen messed up to boot. Worse yet, the preprocessor doesn't use the standard mnemonic codes for the 8087; it forces you to use its own.

The sheet explaining how to install the 8087 chip is adequate but lacks any drawings to help you or make you feel safer. (Where is switch 1 toggle 2? Each customer has to look it up in the IBM books—somewhere—because Micro Ware doesn't provide a drawing.) This is just a partial list of complaints.

What really seems to be wrong with Micro Ware's product is twofold. First, the company is spread thin; too much to do, too little time to do it right. In this regard, you may expect improvement from them. Second, the documentation has a "techy" approach and doesn't explain the product clearly. If you aren't the sort of person who feels comfortable with a soldering iron in your hand, you aren't the person for whom the documentation's written. The pc public expects and deserves better. On the other hand, Micro Ware users have given them good marks for customer support over the telephone.

Anyone contemplating buying Micro Ware's software should be prepared for a lack of friendliness. But the stuff works and works well. That's the bottom line. pn

8087 Drivers, Micro Ware (Box 79, Kingston, MA 02364; 617-746-7341). $150 each.

Tigers in the Snow. By Edward Haar. At 5:30 a.m. on December 16, 1944, Adolf Hitler launched the offensive he called Wacht am Rhein, later known as the Battle of the Bulge. Both sides used this pocket-sized battle as an opportunity for a PR offensive, and it has since been commemorated in the movie *Patton* and about a dozen less memorable flicks. Now you have the opportunity to sit in Hitler's chair (or Eisenhower's, if you prefer) and gamble the lives of soldiers struggling in the snowy Ardennes. (The "tigers" of the title are the intimidating German Tiger tanks that threaten to come grinding at you from the cover.)

On the screen, the Ardennes looks like a map with colorful, little symbols representing trees, hills, rivers, and towns. (The swamps and narrow, congested roads that made things so difficult for the Wehrmacht are not evident.) Each military unit appears as a soldier (for infantry) or a tank (for armor). Every unit has a rating for combat strength and movement allowance. Combat strength is a rough measure of military power for attack or defense. It tends to decline as the game progresses, the perpetual violence wearing down men and machines. Movement allowance represents a unit's ability to churn up the snow, spending so many points to occupy a town or ford a river.

It gets more complicated. The computer keeps track of details like the supply situation, Allied air interdiction, available artillery, fuel shortages, and more. It assigns victory points for slaughtering enemy soldiers and occupying certain objectives. If Eisenhower wins the game, the machine plays the theme from *Patton*. Otherwise, it's *Deutschland ueber Alles.*

What the computer does not do is let you maneuver your units in any order you please. You get just one opportunity per turn to move a particular unit. If there is something else you need to move first, too bad. The same is true of combat. Still, the flaws in the game are not as bad as the flaws in the documentation. A player may struggle all through the game to meet certain objectives, only to find they are completely useless. In choosing to translate this game for the IBM, Strategic Simulations chose not a popular game, but an easy one to program.

Still, it is pointless to say this is not the best war game ever implemented for a computer. It is certainly the best ever implemented for the IBM. If the idea of walking in Patton's footsteps pleases you, give it a try. fj

Tigers in the Snow, by Edward Haar, Strategic Simulations (465 Fairchild Drive, Suite 108, Mountain View, CA 94043; 415-964-1353). Color/graphics adapter required. $39.95.

Word Attack! By Janice G. Davidson, Ph.D., and Richard K. Eckert, Jr. At a time when too much of the drill and practice software available is of questionable value, Davidson and Associates's *Word Attack!* comes as a welcome surprise. This well conceived, well executed drill and practice program for building vocabulary serves as a much needed reminder that the phrase drill and practice need not be synonymous with dull and deadly.

The purpose of the program is to help people in grades four through twelve increase their vocabularies. As the authors explain at the beginning of the documentation, *Word Attack!* is not meant to be students' only vocabulary-building tool, particularly since it does not teach pronunciation or the multiple meanings of words. What the program is meant to do is help students learn to recognize, define, and become comfortable with new words.

The main learning process consists of three activities (each of which builds on the last) supplemented by a final—and fun—reinforcement activity. The program has nine levels of difficulty, each containing seventy-five words, divided into twenty-five-word groups of adjectives, nouns, and verbs.

First, each word in a given list is displayed on-screen, along with a synonym or brief definition and a sentence in which it is used correctly. Users are encouraged to run through this exercise until they have the words and their meanings firmly in mind.

Next comes a multiple-choice quiz that can be set up two ways. In normal mode, the word is given and the correct meaning must be

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Other spelling checkers "borrow" their words from printed dictionaries —or copy them from old word lists. Or give a programmer who can't spell "programmer" a chance to write his first dictionary. And as though all this wasn't bad enough, a lot of these companies want to charge you $100, or $200 or even $300!

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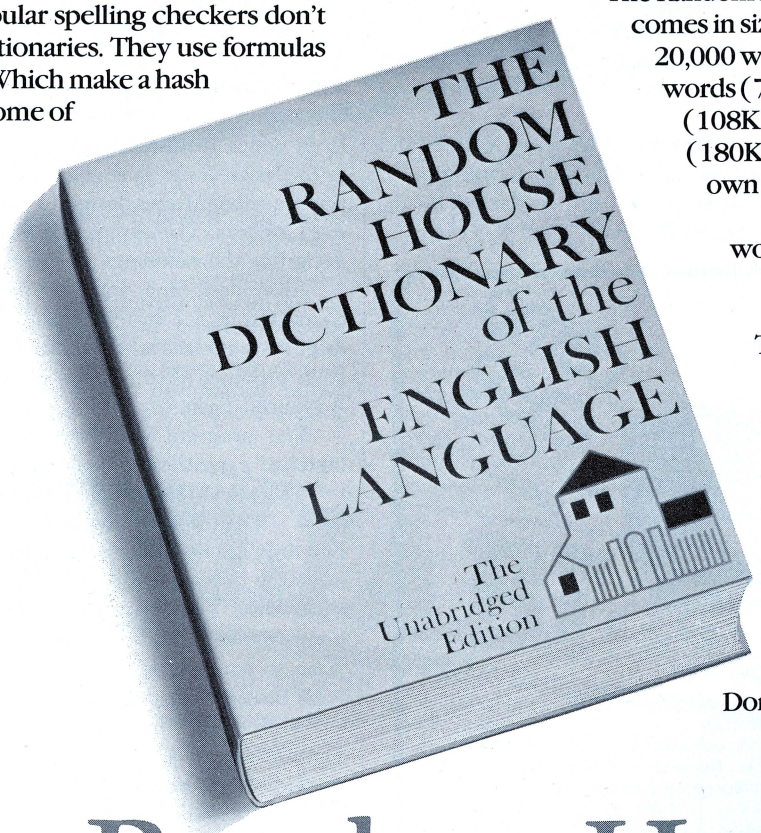

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selected; in reverse mode, a meaning is given and the correct word must be chosen to go with it.

In the sentence-completion section, learners are asked to supply the missing word in the sentence. It will be one of the twenty-five words under study.

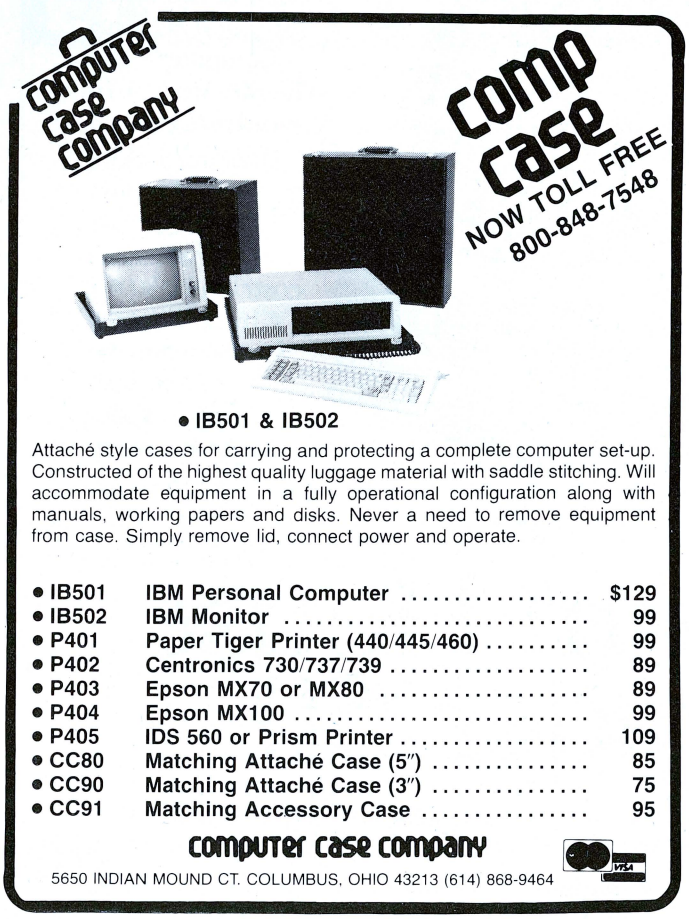
When learners are convinced they know all twenty-five words in a list, they can test that assumption by playing *Word Attack!*, the entertaining arcadelike game for which the package is named. Four words and one definition appear on the screen and the player must find and shoot down the correct one before time runs out. The game has three different speeds and is an effective and painless way of using and reinforcing new knowledge. Some kids will want to start out here, rather than progress through the first three learning exercises; that's fine. It will soon become clear that doing really well at the game hinges on knowing the meanings of the words.

The program is still useful after the words on the disk or on a given level have been mastered. Supplementary data disks, containing 500 words apiece and designed for learners at various grade levels, are available from Davidson and Associates for $19.95. In addition, teachers, parents, and older kids can create learning materials of their own by using the editor function of the program and storing the results on an initialized data disk.

The inclusion of the editor program does much to ensure that *Word Attack!* will continue to be used by various members of a family or students in a class. A clearly written chapter in the documentation provides a step-by-step explanation of how to use this useful tool. It also identifies the editor's limits—words can have a maximum of thirteen letters, meanings a maximum of thirty-six letters and spaces, and sentences a maximum of 120 letters and spaces.

The program documentation is suitably brief, easy to read, and attractively presented. Alphabetized word lists and definitions for each of the nine levels are provided at the back of the book. JD

Word Attack! by Janice G. Davidson, Ph.D., and Richard K. Eckert, Jr., Davidson and Associates (6069 Groveoak Place, Suite 12, Rancho Palos Verdes, CA 90274; 213-378-3995). $49.95.



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Three Game Package. The three games that make up this package (*Stock Market, Planet,* and *Drag Race*) are well documented, easy to use, and, considering their cost—$10 per game—fun to play. You'll need to correct a programming error in *Drag Race;* otherwise the programs are an excellent bargain. (A discussion of the error and how to correct it is included in the review of *Drag Race,* below.)

Stock Market lets you test your financial savvy against the unpredictable forces of the market. You are an investor with $10,000 to speculate. The Big Board has nine stocks that fall into one of three categories: preferred stocks with a low rate of return but a low risk factor, blue chip stocks with higher rate of return but slightly less stability, and speculative stocks whose prices swing wildly. You buy and sell the stocks during each time period to try to increase your worth. You can invest cautiously, or you can risk your entire fortune on a single market upturn.

The on-line documentation explains clearly what the object of the game is and how to use the program. There are many options, fortunately or unfortunately, and you will need to print out the options to remember them all (use the print-screen key).

Planet is a simulation of an entire world economy (a planetary *Stock Market*). Decisions you make about fourteen key budget items determine how the ecology, economy, and happiness of the planet's inhabitants will fare. The game ends when any of these factors falls below zero. There are some surprises in this game! Recommended.

Are you tired of what Detroit and Tokyo have to offer? In *Drag Race* you are the car designer. You specify the horsepower, the tire size, and the rear-end ratio for your car. Each factor has a definite effect on the car's performance, though it will take you some time to learn which factors are the most important. The object of the game is to design a car that will win consistently. Your very clever computer opponent also designs a car and after a few races can be very hard to beat. The computer's strategy seems to be to use your car's design in the next race if you beat it the first time.

After designing your car, you specify the length of the racecourse—from one to nine thousand feet. Character graphics are used to portray the actual race, but a great deal more realism could have been provided through the use of the full graphics capabilities of Advanced Basic.

The program was delivered with a bug. Line 1100 has unmatched parentheses. To correct the bug, change line 1100 to read:

```
1100 RAMDOMIZE(VAL(LEFT$(TIME$,2))+
     VAL(MID$(TIME$,4,2)))
```

Not only are the three games—*Stock Market, Planet,* and *Drag Race*—not copy protected but instructions are provided for making a copy of the disk. The use of Basic allows the player to look in at the programs to see how the games work, and, in the case of one game at least, to correct the bugs. PG

Three Game Package, Software Laboratories (6924 Riverside Drive, Dublin, OH 43017; 800-531-1309). $10 each; $20 for all three.

FlippinGame. This is a pc implementation of the well-known board game *Othello.* You play against the computer, whom you set to either of two skill levels. The game runs in either mono or graphics; the mono version uses light and dark happy faces for markers—on an eight-by-eight grid built of text graphics.

FlippinGame's lower skill level is suitable for beginners or for those who don't like to wait while the computer thinks. At the more advanced level your pc, now a more formidable (though certainly beatable) opponent, deliberates fifteen seconds or so before each move.

Othello is a fascinating game, and this is a well behaved, well error-trapped, if not overwhelmingly competitive, rendition of it. The game is coded in protected BasicA. CS

FlippinGame, by Harry J. Foxwell. SCC Games (9025 Andromeda Drive, Burke, VA 22015; 202-872-4433). $19.50. ▲

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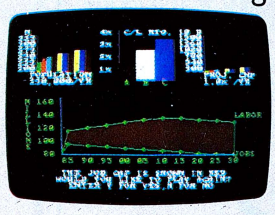

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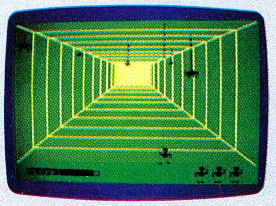

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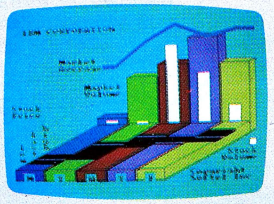

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Snooping in ROM:

THE COMPUTER MUSICIAN

by Peter Norton

In the first three parts of this series, we started looking at the read-only-memory (ROM) programs built into the IBM Personal Computer. Part one pointed out their locations and revealed how to explore them. Part two discussed the differences between the two versions of the ROM BIOS programs. In part three, we saw how the service routines are accessed, why they're accessed as they are, and how you can override the ROM programs.

Here we'll cover something not supported in the ROM at all—how to make sounds on the speaker. At the same time, we'll learn a little more about how interrupts work on the pc and about the computer's programmable timer.

There are, regrettably, no ROM BIOS general service routines for the speaker that's built into the pc. Although there are two different subroutines in the ROM BIOS to sound the speaker, neither is set up to be used in any fashion except from within the ROM BIOS; they are not service routines for our use.

Using the Speaker. To start, let's look at how the speaker works and see how we might activate it. Two assembly-language programs, shown in listings 1 and 2, illustrate how the speaker is used and show how you can make your own unique sounds.

Any speaker, whether part of a hi-fi system, a telephone, or the speaker in the pc, works by receiving a stream of electrical pulses that drive the speaker's diaphragm in and out; the in-and-out movement of the diaphragm produces pulses of air movement that the ear interprets as sound. On an ordinary speaker, the signal pulses going into the speaker vary in strength (volume) and timing (frequency or pitch). For the simple speaker system on the pc there is no volume control; the sound is produced very simply by a series of pulses of electricity. The current to the speaker is either on or off, in a strictly binary way. The frequency of these pulses controls the frequency, or pitch, of the speaker. For example, if the current is turned on and off three hundred times per second, the speaker produces a sound whose frequency is 300 Hz.

The circuitry controlling the speaker is very interesting; pulses sent to the speaker are controlled by a software signal and a programmable timer. The use of the timer is optional; hence, there are two ways to make sounds.

Let's look first at how it's done without the timer. To make a sound, an assembly language program must pulse the speaker at the right rate for the right length of time. Although the program itself has to be coded in assembly language, we can use an informal kind of Pascal to show the logic of it.

Suppose we want to make a 300 Hz tone and we want it to last for half a second. This is what we do:

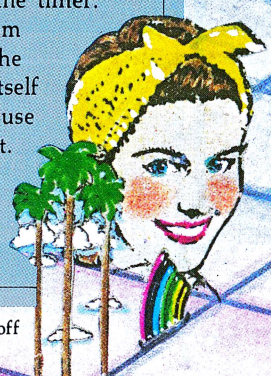

Illustration by Barry K. Hoff

This article is taken from the forthcoming book, Inside the IBM/PC: Access to Advanced Features and Programming, *published by the Robert J. Brady Company.*

```
REPEAT 150 times (* that's half a second at 300 cycles per
                    second *)
  pulse the speaker out
  kill time for 1/600th of a second (* a half cycle *)
    (*killing time is done with a do-nothing loop, repeated
    the right number of times *)
  pulse the speaker back in
  kill another 1/600th of a second (* the other half cycle *)
END;
```

The assembler program given in listing 1 does exactly what this little program skeleton shows. In case you're new to assembly-language programs for the pc and you're wondering what they look like, listing 1 will give you a very simple introduction; if you want to know what the steps are to get an assembly-language program ready to execute, the comments in listing 1 will show you.

This way of making sounds and the program given in listing 1 bring up something interesting about how the pc works and about how it keeps track of time.

Interrupts. In previous articles we saw how the ROM services are invoked by means of interrupts. Interrupts are used by the pc for several purposes. One is to request ROM and DOS services; another is to signal events outside the computer's microprocessor. These outside events include such things as the pressing of keys on the keyboard.

To make it possible for the pc to keep track of the time and date, the computer's internal clock is set up to create timer interrupts on a regular basis—about eighteen times per second. When a timer interrupt occurs, the ROM service programs in the pc increment a counter; by this procedure, the computer tells time. The timer interrupt is a very quick operation, but it briefly disrupts the execution of any program running on the pc.

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If the program that's running is the sound-generation program shown in listing 1, the brief timer interruptions will disrupt the pure sound the program would otherwise generate; the result is a warble instead of a pure tone.

To keep this from happening, interrupts can be suspended by means of a CLI instruction (for CLear the Interrupt flag). After a CLI has been issued, the 8088 ignores interrupts (or holds them in suspense) and continues with its programs unharassed. The reverse instruction, STI (for SeT the Interrupt flag), turns interrupts back on.

The program given in listing 1 contains the CLI and STI instructions. If you assemble and run it as it appears, you'll get a pure sound on the pc's speaker. If you then take out the CLI and

```
; Beep and Warble programs
; (C) Copyright 1982 Peter Norton
; This program, run in two versions, will demonstrate the effects of
; clock interrupts on a program that generates a pure tone on the
; speaker.
; The BEEP version, with interrupts disabled, will produce a pure
; tone.
; The WARBLE version, with 18 clock interrupts each second, will
; warble.
; The listing here includes the CLI and STI instructions, which
; disable interrupts, for the BEEP version. For WARBLE, remove
; these instructions.
; If you are new to preparing assembler programs for execution,
; here is a quick guide. After entering the program into a text file
; named BEEP.ASM do these three steps:
; 1) assemble the program, with MASM B:BEEP,B:BEEP,CON;
; 2) link the program with LINK B:BEEP,B:BEEP,CON;
; 3) convert to "COM" format with EXE2BIN B:BEEP.EXE
;    B:BEEP.COM
; This program operates by sending a series of on and off pulses to
; the speaker; the speed of the pulses is controlled by a loop that
; just kills time for 50 loop cycles. The length of the tone is
; controlled by the number of speaker-pulse cycles (3000 in this
; program).
beepseg segment 'code'
  assume  cs:beepseg
beep    proc    far
        cli                 ; clear-interrupts—remove this for
                              WARBLE
        mov     bx,3000     ; count of speaker cycles
        in      al,61h      ; input control info from
                              keyboard/speaker port
        push    ax          ; save on stack
more:   and     al,0fch     ; turn off bits 0 and 1 (speaker off pulse)
        out     61h,al      ; send command to speaker port
        mov     cx,50       ; time for tone half-cycle
11:     loop    11          ; kill time
        or      al,2        ; turn on bit 1 (speaker on pulse)
        out     61h,al      ; send command to speaker port
        mov     cx,50       ; time for tone half-cycle
12:     loop    12          ; kill time
        dec     bx          ; count down of speaker cycles
        jnz     more        ; continue cycling speaker
        pop     ax          ; restore speaker/keyboard port value
        out     61h,al      ; send port value out
        sti                 ; start interrupts—remove this for
                              WARBLE
        int     20h         ; return to system
beep    endp
beepseg ends
        end
; End of BEEP and WARBLE
```

Listing 1.

STI and reassemble the program, you'll get a warbling sound.

(If you don't have an assembler but would like to try the programs shown here, we'll send you a disk with the programs ready to use. Just send $5 to cover the costs of disk and mailing to Softalk Speaker, Box 60, 11160 McCormick Street, North Hollywood, CA 91603.)

Now what you've seen so far is a perfectly good way to make a sound, but the drawback is that you can't do any other work on your computer while the program is running. In fact, that little program uses the awesome power of the 8088 to do nothing but count time and generate speaker pulses. There is a better way to do it—by using the timer.

One of the hidden features of the pc is a programmable timer. The timer doesn't really time anything; it just counts pulses of the basic system clock. The pulses it counts are not the same as the eighteen-per-second timer interrupts. Rather, they are the fundamental pulses that drive all the circuitry of the pc.

Divisors. It is possible to specify a *divisor* for the timer. The timer will then count the system clock pulses and compare the number of pulses counted to the divisor. Every time the pulse count equals the divisor, the timer will send out a signal and start counting again from zero.

The system clock cycle runs at more than one million pulses per second—1.19 million, to be exact. So if the timer is programmed with a divisor of 10,000, it will put out a signal about one hundred times a second. Practically any timer output frequency can be generated by loading the appropriate divisor into the timer.

```
; "A440" Sound generated with the IBM/PC timer
; (C) Copyright 1982 Peter Norton
; This program demonstrates how to generate sounds using the pc's
; timer/speaker connection. It generates a frequency of 440 cycles
; per second, the musical note A.
; This program will start a sound that will continue indefinitely.
; As with the BEEP/WARBLE program in listing 1, these steps are
; used to prepare the program for execution. First enter this
; program, using an editor, into a file named "A440.ASM." Then
; do these steps:
; 1) assemble the program, with MASM B:A440,B:A440,CON;
; 2) link the program with LINK B:A440,B:A440,CON;
; 3) convert to "COM" format with EXE2BIN B:A440.EXE
     B:A440.COM
a440seg segment 'code'
   assume cs:a440seg
a440   proc  far
; Step 1—prepare the timer to receive its divisor
       mov   al,0b6h   ; timer mode register signal
       out   67,al     ; output to timer control port
; Step 2—send the divisor count to the timer
       mov   ax,2711   ; divisor for 440 cycles
       out   66,al     ; output low-order byte of divisor
       mov   al,ah     ; move high-order byte into output
                         register
       out   66,al     ; output high-order byte of divisor
; Step 3—turn on the two bits that activate the speaker and the
         timer's control of the speaker
       in    al,97     ; get the current bit settings for port 97
       or    al,03     ; turn on last two bits
       out   97,al     ; send back the new value
; Step 4—return control to DOS
       int   20h       ; return to system
a440   endp
a440seg ends
       end
; End of "A440"
```

Listing 2.

When a divisor is loaded into the timer and the speaker circuitry is activated to be driven by the timer, the timer's output signal will drive the speaker at whatever frequency the timer is generating; the computer, meanwhile, will be free to go on with its work.

This way of operating the speaker lets programs run while sounds come out of the speaker. That is the principle behind the *mb* (music in the background) option of the *play* statement in Advanced Basic.

Listing 2 shows in detail how the programmable timer can be used to create sounds on the speaker. It shows how to set up the timer to produce its signals and how to instruct the speaker to work under the control of the timer signals. You have to do both of these things in order to drive the speaker with the timer.

The timer approach to sound generation has two obvious advantages over the interrupt approach. First, it doesn't tie up the power of the computer; it allows other parts of your program to carry on while sounds are being generated. Second, it isn't in conflict with the computer's interrupt mechanism, so you can get pure sounds and still leave the interrupt system working, servicing the keyboard, the clock, and everything else.

There is, however, a minor *disadvantage* to making sound with the programmable timer. Since the sounds will go on forever, any program generating them must do something to stop them when they should stop. There are two good ways to do this. One is to check the time of day periodically to see if enough time has elapsed, and the other is to set up a timer-interrupt program to be activated on each of the eighteen clock ticks per second. Each of these methods works well, but both are something of a nuisance to set up.

We've seen here the two fundamental approaches to sound generation on the IBM pc. In a later article we'll explore the workings of interrupts in more detail. ▲

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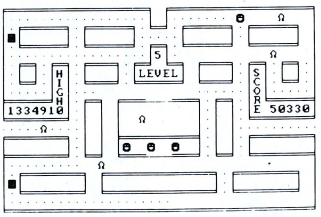

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BOARDS & BUSES

by Steve Schmitt

One of the chief obstacles to the migration of software from one microcomputer system to another stems from the differences between CPUs. Software written to run on one processor, such as the Z-80, will almost certainly require a drastic overhaul before it can be made to run on another, such as the pc's 8088.

One popular way around this obstacle is to add a second microprocessor to the system. Put a Z-80 coprocessor in the IBM pc, for example, and the machine can run Z-80 software as well as software written specifically for the pc.

When you weigh the cost of this hardware solution—usually a microprocessor board with a few support chips—the technique proves very economical. The alternative technique, that of modifying the programs, takes time and involves considerable software expenses. If what you're trying to "port" is a large body of, say, CP/M software, the hardware approach begins to look pretty attractive.

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This month's column takes a look at the subject of coprocessor boards and examines one card that can greatly enhance the IBM Personal Computer's software repertoire.

The Baby Blue Board. The Baby Blue package, by the Xedex Corporation, brings the world of CP/M-80 to the IBM Personal Computer. Basically, the card provides a Z-80B coprocessor and an additional 64K of memory. Xedex includes software for porting CP/M programs to the pc and for operating CP/M programs within the PC-DOS environment.

To run a CP/M-80 program on the Baby Blue, you must follow a simple two-step procedure. First you convert the CP/M program file to PC-DOS format. This is the more potentially troublesome part of the procedure. The microcomputer industry still lacks an effective, standard mechanism for transferring data—especially non-character binary data.

After you load the desired CP/M file, the next step is to attach an 8088 routine to the CP/M program. This special "header" code sets up a CP/M environment, coordinates I/O activity, and transfers execution control to the Z-80 processor.

Once the CP/M-80 file is prepared, you simply execute the program from the system prompt, just as you would any other PC-DOS utility. When you're not running CP/M files, you have an extra 64K to play with, thanks to Baby Blue's on-board memory.

The software accompanying the Baby Blue card falls into three categories: diagnostics, file conversion, and PC-DOS integration. The diagnostics routines test the Z-80 and the on-board memory. You can transport software to the pc by either of two methods—over

Incompatibilities with the CP/M Interface

Feature	Incompatibility	Ramification
Direct BIOS calls	All work except disk I/O functions.	Usually none. Typically not found in applications.
IOByte	Not implemented.	Programs that use the IOByte will not work. Not very common.
File attributes	Not implemented.	Not too common, usually used by CP/M OS.
Submit facility	Not implemented.	Use the PC-DOS batch facility.
Special file name characters	Some not recognized by PC-DOS.	Translated to legal file name characters.
Minor disk/file parameters	Do not translate to PC-DOS file system.	Use BDOS file/disk access only.

Table 1.

a data communications link with the serial port or with a disk conversion utility. Xedex provides the popular public domain program *Modem-7* for transferring files from CP/M machines. Most communications software for the pc restricts transfers to character data. The reason for this restriction is that programs (binary data) can take on *any* byte value; hence, it's difficult to flag the end of a transmission by means of a special code. *Modem-7*, by Ward Christensen, does allow the transfer of binary information.

Two words of warning: the *Modem-7* program requires some modification if you're not using a PMMI (Pacific Micro Magic, Inc.) modem. In addition, the system you communicate with must also run *Modem-7*. Modifying *Modem-7* requires some technical expertise (and the Digital Research *Mac* assembler) and can be messy.

The disk conversion utility offers an easier route for loading CP/M programs. Menu-driven and simple to operate, the software helps you quickly develop a PC-DOS disk full of CP/M programs. Unfortunately, the conversion supports only four 5¼-inch-disk formats. And (of course) they're not very common types. What this country needs is a good five-cent standard for transferring software.

Documentation for Baby Blue comes across quite well. The user manual is written at a low technical level and does a good job of hand-holding. Installation and operation steps are clearly defined, and the style is light and interesting. Although the manual explains the theory of operation, technical buffs will be disappointed by a lack of thorough technical discourse. Appendixes, however, do list some system interface specifications. Documentation for the communications programs comes on the disks containing that software.

Installation of the board takes only a few minutes. Two dip switches, one on the pc motherboard and the other on the card, must be set. These have to do with the size of system memory and the location in main storage where Baby Blue's RAM is to reside.

Baby Blue Package Description

Cost:
$600
Configuration Requirements:
64K system memory (before)
1 160K drive
IBM pc display
Applications:
64K system memory expansion
CP/M-80 software applications (version 2.2)
Advanced control and processing functions (peripheral control)
Concurrent processing
User Experience Level:
Novice: little experience needed to install, configure, and run CP/M software.

Version:
3.0 (December 1982)
Software Format:
(2) 160K diskettes
Includes diagnostics, CP/M-80 conversion utilities, Modem-7
Physical Specifications:
64K dynamic RAM, dual-ported, with parity, 200ns R/W time
Z-80B microprocessor, 4.77 MHz
11 x 4 inches (try not to put in the last slot by speaker)
Emulates TeleVideo 950 terminal

Table 2.

The Baby Blue package employs some interesting techniques for running CP/M-80 under the foreign PC-DOS system. What's significant is that neither the operating system nor the CP/M application program itself is modified. Briefly, let's explore the inner workings.

As previously mentioned, Baby Blue software attaches a special program to the beginning of your CP/M program. When you invoke your CP/M routine, this header code is executed first. The code is a composite of 8088 and Z-80 instructions. The 8088 part runs first; it loads the CP/M program into Baby Blue's 64K memory, establishes the standard CP/M base page memory layout, starts the Z-80 processor at location 100H (in Baby Blue's memory space), and then loops, waiting to handle CP/M system I/O functions. Since the TPA (program area) occupies about 63.5K, the system handles the largest of CP/M utilities.

The small resident Z-80 portion of the header converts CP/M system calls into equivalent PC-DOS format and passes them to the waiting 8088 processor. Hence, both processors work simultaneously; you have a multiprocessing system. File requests translate into PC-DOS-compatible operations. Header code causes the display monitor to function as if it were a TeleVideo 950 terminal.

How close is this approach to garden-variety, no-frills CP/M systems? Surprisingly close. Table 1 lists the major differences. Products conforming to CP/M software guidelines encounter few difficulties. In general, if a program doesn't work on the Baby Blue it either follows a questionable programming practice (such as making direct BIOS calls) or it takes advantage of features for a specific hardware configuration.

Some standard CP/M utilities also fail to function with the Baby Blue setup. *Stat* gives wrong answers, primarily because there is no corresponding IOByte function under PC-DOS. *DDT* cannot perform a save operation—among other limitations. *PIP* works for the most part, but with a few subtle differences from the way it works

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under normal CP/M systems. Also, some applications combining code and data in overlay files encounter problems because of the Baby Blue card.

In spite of these anomalies, you can expect about 95 percent of the CP/M application software base to perform correctly. Software companies realize the advantages of highly transportable programs (that's what CP/M is all about) and usually stay away from potential incompatibilities. Table 3 lists CP/M software verified to work with the Baby Blue (the table also discusses compatibility with a few hardware add-ons). Xedex maintains a list of forty tested programs; the actual total number of programs that run under Baby Blue probably is in the thousands.

The Baby Blue package adds considerable horsepower for a very reasonable price. New pc owners with a large prior investment in CP/M-80 software can really benefit from this add-on. In addition, the package opens up a long list of proven, inexpensive software for the pc. You don't have to learn a new operating system to use the software, since everything works under the familiar PC-DOS. And the Z-80 processor increases the system's net computing capacity.

One caveat: you should have few problems with programs failing to run under Baby Blue, but you may encounter difficulty in getting CP/M software onto the pc. Xedex will assist customers with such problems. Their representatives seem eager to help and are generally knowledgeable.

Other Ways To Use a Coprocessor Board. Microprocessor boards offer some interesting avenues for extending the pc. In addition to broadening the scope of available software, the coprocessor can work in conjunction with the host 8088 for advanced applications. It can also be used for continuous system checking, complicated file system operations, and peripheral control.

For example, the board could test system components for problems during normal operation. You can avoid some nasty data losses via this technique. Another valuable application might be an interface for some graphics device, such as a plotter. One manufacturer uses the Baby Blue card to run CP/M-80 software with its twenty-megabyte hard disk. Concurrent processing, special-purpose processors (p-code machines, for example), and a network communications interface (such as Ethernet) are other possibilities.

Another potential use of coprocessor boards is to provide upgrades for your system. A board with an iAPX-186 processor, a higher-performance version of the 8088, could improve execution speed by a factor of 66 percent. Another exciting possibility that may be in the offing is an iAPX-286 processor board for the pc. Add-ons of this kind could provide a growth path toward whatever new products may be coming from IBM.

The ALS Board. Another coprocessor product that will soon be available for the pc is the ALS (Advanced Logic Systems) CP/M Plus card. Similar in most respects to the Xedex board, this card will also support the recently released CP/M 3.0. This means you will be able to use the new CP/M graphics package with an IBM pc. In addition, CP/M 3.0 significantly improves the file system and takes advantage of memory spaces larger than 64K.

The project is a joint venture of Digital Research (creators of CP/M) and ALS. The result should be a very clean implementation of CP/M-80 for the pc. A version of the card for the Apple II is already in production. ▲

Baby Blue Test Results

Software/Hardware Tested	Works with Baby Blue?	Comments
Software:		
Supersoft Ada	yes	Small Ada compiler. Both the compiler and generated programs work.
Pascal MT/+	yes	No problems.
WordStar/Mailmerge	yes	TV950 emulation very nice. No problems.
dBase II	yes	No problems.
ASM (DRI assembler)	yes	No problems.
CBasic	yes	No problems.
Microsoft Basic	yes	No problems running Basic applications.
PIP	most of the time	Error detection and IOBYTE related procedures do not work.
Stat	no	No real CP/M disk environment or IOBYTE.
DDT	partially	Can't do Save–some other minor problems.
Plink2	no	Code and data mixed in single file.
Hardware:		
Corvus 6MB disk	yes	No problems.
Tallgrass Technologies 12/20MB disk	yes	No problems.
AST Megaplus board with 512K bytes and serial port	yes	Neither asynchronous port nor additional memory conflicts with Baby Blue operation.

Table 3.

Schmitt is a consultant specializing in microcomputer software, small system research, and technical writing.

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THE BASIC SOLUTION

BY JOE JUHASZ

One of the nicest features of the pc is its graphics capability. Few computers, large or small, make graphics as accessible. Even beginners can create graphs and drawings on the screen using simple Basic commands.

Unfortunately, it's not quite so easy to produce hard copy of your graphics creations. Although the pc's print-screen key does a good job of printing text from your monitor, it won't print graphics. How, then, does one produce hard copy?

Many products, ranging in price from thirty to sixty dollars, will produce hard-copy graphics. Each has pluses and minuses. Some are written in assembler and are quite fast. Some are very flexible and create many types of images. Some even replace the print-screen key.

The graphics dump routine that follows was taken from *PCcrayon*, a general-purpose graphics package published by PCsoftware. The code, written in BasicA, can be added easily to your BasicA programs.

Since it's written in BasicA, the routine does take some time to run; expect eight to nine minutes. Lines 1000 through 1020 assist performance by defining all variables as integers, and those most frequently used are first.

If you're unable to define all variables as integers, rename the variables used in the graphics dump routine to end with the % character. Example: P becomes P%, I becomes I%, and so forth.

As a final performance enhancement, you can remove all the comments from the routine. For optimum performance, the routine can be compiled; it would then take about four minutes to run.

Lines 1030 through 1040 set the F10 key to execute the graphics dump routine. Whenever you want hard copy, you need only press that key.

In lines 9120 through 9130, the graphics dump routine sets F1 to halt the hard copy and return to your program.

Line 9150 points to the color/graphics adapter buffer. Programmers out there may want to point to the monochrome display buffer (DEF SEG=&HB000) and play around with lines 9180 through 9300 to create hard copy of the monochrome screen, including special text characters. If you succeed, a word to *Softalk/IBM* would be appreciated.

A carriage return in ASCII is 13. We can't send this character to the printer or we'll get unneeded line feeds. Instead, we'll send CHR$(9), which is just one dot different from CHR$(13).

You'll notice that in line 9290 we print four copies of each byte. The reason is that the resolution of the graphics screen is 640 dots by 200 dots, or greater than three to one. You may wish to experiment with this line for different results.

Future installments of the Basic Solution will include a Basic program lister and print formatter, a Basic program condenser, a general-purpose Basic field input routine, and more graphics utilities.

Send your questions, problems, or requests to:

The Basic Solution
Softalk for the IBM pc
Box 60
North Hollywood, CA 91603

We'll try to answer selected questions in future columns. ▲

```
1000  DEFINT A-Z                                  'Define all variables as integers for speed
1010  DIM P(200)
1020  I=0:Y=0:X=0:B=0:C=0                         'Define highly used variables early for speed
1030  KEY(10) ON                                  'Enable FUNCTION KEY 10
1040  ON KEY(10) GOSUB 9100                       'When F10 pressed then print graphics screen
1050 '
1060 '  ***************************
1070 '  ***  YOUR PROGRAM  ***
1080 '  ***************************
9000 '
9010 '  ***************************************
9020 '  ***  Graphics Screen Dump Routine  ***
9030 '  ***                                ***
9040 '  ***  for:                          ***
9050 '  ***  IBM / EPSON MX8O / MX100 ***
9060 '  ***  with graftrax plus             ***
9070 '  ***************************************
9080 '
9090 '
9100  '***—Entry Point—***
9110 '
9120   KEY(1) ON                                  'Enable FUNCTION KEY 1
9130  ON KEY(1) GOSUB 9330                        'When<F1>pressed then halt print
9140  WIDTH "LPT1:",255                           'Set printer to infinite width
9150  DEF SEG=&HB800                              'Point PEEKs to GRAPHICS BUFFER
9160  'Set linefeeds to 8/72 of an inch
9170  LPRINT CHR$(13);CHR$(10);CHR$(&H1B);"A";CHR$(8);CHR$(10);
9180  FOR I=0 TO 79                               'Loop for screen data for columns 1 thru 80
9190    'Set printer to graphics mode, 800 bytes of data per line
9200    LPRINT CHR$(10);CHR$(&H1B);"L";CHR$(&H20);CHR$(&H3);
9210    FOR Y=0 TO 99                             'Loop for screen data for entire column
9220      X=I+(80*Y)                              'Calculate position in graphics buffer
9230      C=PEEK(X): B=PEEK(8192+X)               'Get data
9240      IF C=13 THEN C=9                        'Eliminate data=13 (carriage return)
9250      IF B=13 THEN B=9
9260      P(Y)=C: P(Y+100)=B                      'Save in array
9270    NEXT
9280  'Print out an entire column from graphics screen
9290  FOR Y=99 TO 0 STEP -1:LPRINT STRING$(4,P(Y+100));STRINGS$(4,P(Y));:NEXT
9300  NEXT
9310  GOTO 9350
9320   ' <F1>was pressed
9330  RETURN 9350                                 'Get rid of return on stack
9340 'Turn<F1>off
9350  KEY(1) OFF
9360  SOUND 1200,5: SOUND 1000,5                  'Signal end
9370  RETURN                                      'Return to caller
```

part two

THE GRAPHIC ARTS

by George Bohannon

By the end of last month's article ("The ABCs of IBM Graphics"), we had finished discussing the memory map used by the color/graphics adapter; and we had verified, by means of a short Basic program, that the screen buffer occupies the 16,000 bytes beginning at hex address B8000.

This month, as promised, we're going to *peek* and *poke* at this memory range and show some of what you can accomplish by direct manipulation of screen buffer locations.

As we saw last time, there are eighty bytes of buffer memory for each row of pels (pixels). The first eighty bytes control the top row of the screen, row 0, beginning at the left side. The second eighty go with the third row (row 2), also left to right, and so on until all the even-numbered rows are accounted for. Then come the odd-numbered rows, beginning with the second row (row 1).

If we think about this layout, we can determine how to compute the address for the pel at any row and column on the screen. Let's take it a little farther, however, and compute the addresses for all the pels lying within an eight-pel-by-eight-pel character box. That sort of calculation is an extremely useful one, because it eliminates a lot of trial and error when graphics and text are to be combined on-screen. The next example illustrates the address calculation.

Getting Specific. The small program in figure 1 changes part of the screen to reverse video, one character at a time. The program illustrates the following three aspects of graphics-screen control: how to compute pel addresses, how to reverse the state of a group of pels by complementing the buffer contents, and how to play a byte into the buffer.

Let's look at the program in figure 1 more closely. Line 150 starts the Basic working segment at the first byte of the display buffer. Lines 190 through 220 change all forty columns in the first two character rows to reverse video by repeatedly branching to the subroutine at line 250. That subroutine reverses the character box at character position row IR and column IC.

When we *peek* into the buffer, we must *peek* separately at the left and right sides of each character. As we saw last month, each medium-resolution pel takes two bits of buffer memory. Since the character box is eight pels wide, the box must be sixteen bits, or two bytes, wide.

Line 290 computes the address of the byte corresponding to the top row of pels at the left side of the character. The numbers 2 and 320 in that line are easily understood. The 2 is there just because each character is two bytes wide, so we must add two as we go from one text column to the next. The 320 must be added as we go from one text row to the next, because there are four even-numbered rows of pels for each text row and each row of pels takes eighty bytes.

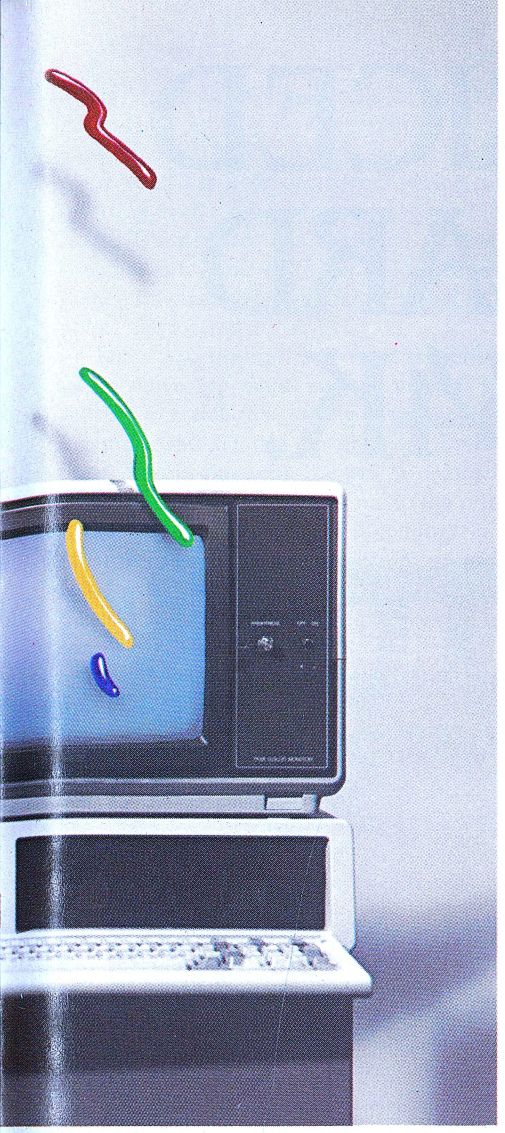
Once we have the address of the even-numbered row, the address of the odd-numbered row directly below it is obtained simply by adding hex 2000. That's done in line 370.

Reverse video is created by changing the 1 bits to 0s and the 0 bits to 1s. That process is called complementing the memory and is accomplished by means of the *not* operator, as in 410 through 440. But it's not quite as simple as it might seem.

The *peek* function in those lines returns the value of the byte at the address given by its argument. The value is returned as a two-byte integer in which the second byte, usual-

```
120 SCREEN 1: KEY OFF : CLS
130 DEFINT I-N
150 DEF SEG = &HB800
170 PRINT TAB (7) "Reverse Video
    Demonstration"
180 INPUT "press enter to go.",X$
190 FOR IR=1 TO 2
200 FOR IC=1 TO 40
210 GOSUB 250
220 NEXT:NEXT
230 LOCATE 23,1:END
250 '
290 IEVEN =2*(IC-1)+320*(IR-1)
330 FOR K=1 TO 4
370 JODD = IEVEN + &H2000
410 IEL = NOT PEEK(IEVEN) AND 255
420 IER = NOT PEEK(IEVEN+1) AND 255
430 JOL = NOT PEEK(JODD) AND 255
440 JOR = NOT PEEK(JODD+1) AND 255
480 POKE IEVEN,IEL
490 POKE IEVEN+1,IER
500 POKE JODD,JOL
510 POKE JODD+1,JOR
550 IEVEN=IEVEN+80
570 NEXT K
580 RETURN
```

Figure 1.



ly called the "most significant byte," is 0. Of course, when we complement that number, the second byte of the result is not 0. Since we really don't care about the second byte, we may be tempted to ignore it, but unfortunately that isn't possible.

When we try to place the complement into the buffer, using *poke*, the Basic Interpreter complains, because the second byte isn't 0. Too bad that *poke* doesn't just ignore the second byte—but it doesn't.

To set the second byte to 0, we use the *and* operator. The *and* simply does a bit-by-bit comparison of two numbers, setting the corresponding bit in its result to 1 if both argument bits are 1, or to 0 if either argument bit is 0. We use 255 for one argument of the *and*, because that number has the special property that all of the bits in its first, "least significant," byte are 1s, and all the bits in its second byte are 0s. Thus, the operation *integer and 255* sets the most significant byte of the integer to 0, while leaving the least significant byte unchanged. That's exactly what we need.

Lines 480 through 510 put the complemented values into the buffer. Finally, line 550 adds eighty to the even row address in order to skip the next even-numbered row of pels in the character.

A Printer Screen Dump. Most people who use the pc for graphics will use a screen dump program at some time. The term *screen dump* refers to the process or result of transferring the display buffer contents to a device such as a disk drive or printer. Thus, the screen dump creates a permanent copy of whatever is on-screen. Of course, when the contents are transferred to a printer, the order in which the contents are sent must be such that the printed result resembles what was on the screen. The organization of the pc's display buffer makes that easy to accomplish.

The primary considerations required for a screen-dump routine are illustrated by the Basic program in figure 2. Since this program is written in Basic, it does not match the speed of the machine-language screen-dump programs now available on the market. Additionally, this simple Basic program is not capable of producing printed graphics in a variety of sizes, as are some of the commercial programs. Nevertheless, it serves as a good introduction to screen dumps.

Before we get to figure 2, a few words about the printer operation are required. This example was designed to work with the IBM dot-matrix printer or the Epson MX-80 or MX-100. Whichever printer you use—IBM or Epson—must have the Epson Graftrax option installed. The Graftrax option is a set of read-only memory chips that allow the printer to interpret and execute graphics commands sent by the computer (all the recent Epson models and the IBM printer have Graftrax built in).

The print head contains nine firing pins, which, when actuated, create dots on the paper. The pins are arranged in a column, with a 1/72 inch separation between each pair of pins. The top eight pins are used for graphics. Commands are sent to the printer in the form of a string of eight-bit ASCII characters. In Basic the characters can be sent by means of the *chr$* function.

In graphics printer mode, each bit of the character controls one of the eight firing pins. The lowest of the eight pins is controlled by the rightmost (least significant) bit of the ASCII control character, while the top pin is controlled by the leftmost (most significant) bit. No pin is fired when *chr$(0)* is sent. Thus, a simple screen dump can be created by sending the display buffer contents, one byte at a time, directly to the printer. Of course, we must still be careful about the order in which the bytes are sent, but the example in figure 2 shows how easy it is to keep things straight.

One point regarding the medium-resolution display should be clarified before we go further. As noted, each medium-resolution pel has two bits of display buffer, and the combination of those two bits determines the color of the pel. The printed graphics are strictly black and white, however. It is not practical in a Basic program to rearrange the individual bits of the display buffer to print a single dot when the pel has a nonbackground color. That would take too much time, although it could be done in a compiled or machine-language program.

Line by Line. The Basic program in figure 2 sends both bits to the printer, so that bit combination 11 prints solid black but the combinations 01 and 10 appear shaded, or gray. Thus, colors can be used to vary the contrast levels of the printed graphics. Note that the default color for most of Basic's graphics statements in medium resolution is the 11 combination.

The program begins by putting something on the screen. Obviously, there is no point in dumping a blank screen to the printer! The screen-dump routine itself begins at line 250.

The output to the printer is via the *print#* statement, although *lprint* is the usual way to send things to the printer. That's because when *lprint* is used, IBM Basic automatically sends a line feed after every carriage return within the string sent to the printer. When graphics are sent to the printer, however, the carriage return character, *chr$(13)*, represents only a particular combination of picture elements. Sending a line feed, *chr$(10)*, after every *chr$(13)* would be disastrous.

Note that in line 300, the printer "file" is opened as a random file. If it were opened as a sequential file, the same problem with *chr$(13)* would occur. We also end each

```
120 SCREEN 1: KEY OFF: CLS
130 DEFINT I-N
170 FOR I = 10 TO 90 STEP 10
180 LINE (I,I) - (320-I,200-I),,B
190 NEXT
200 LOCATE 13,16: PRINT "I "+CHR$(3)+" My P.C."
220 GOSUB 250
230 LOCATE 1,1: END
250 '
280 DEF SEG=&HB800
300 OPEN "lpt1:" AS #1
310 WIDTH #1,255
320 PRINT #1,CHR$(27)"@";
330 PRINT #1,CHR$(27)"A"CHR$(8);
340 PRINT #1,CHR$(27)"D"CHR$(5)CHR$(0);
360 FOR IC=0 TO 79
370 PRINT #1,CHR$(9);
380 PRINT #1,CHR$(27)"K"CHR$(144)CHR$(1);
390 IA=IC+7920
400 FOR JY=1 TO 100
410 J=PEEK(IA):K=PEEK(IA+&H2000)
420 PRINT #1,CHR$(K)CHR$(K)CHR$(J)CHR$(J);
430 IA=IA-80
440 NEXT
450 PRINT #1,CHR$(13)CHR$(10);
460 NEXT
470 PRINT #1,CHR$(13)CHR$(12);
480 RETURN
```

Figure 2.

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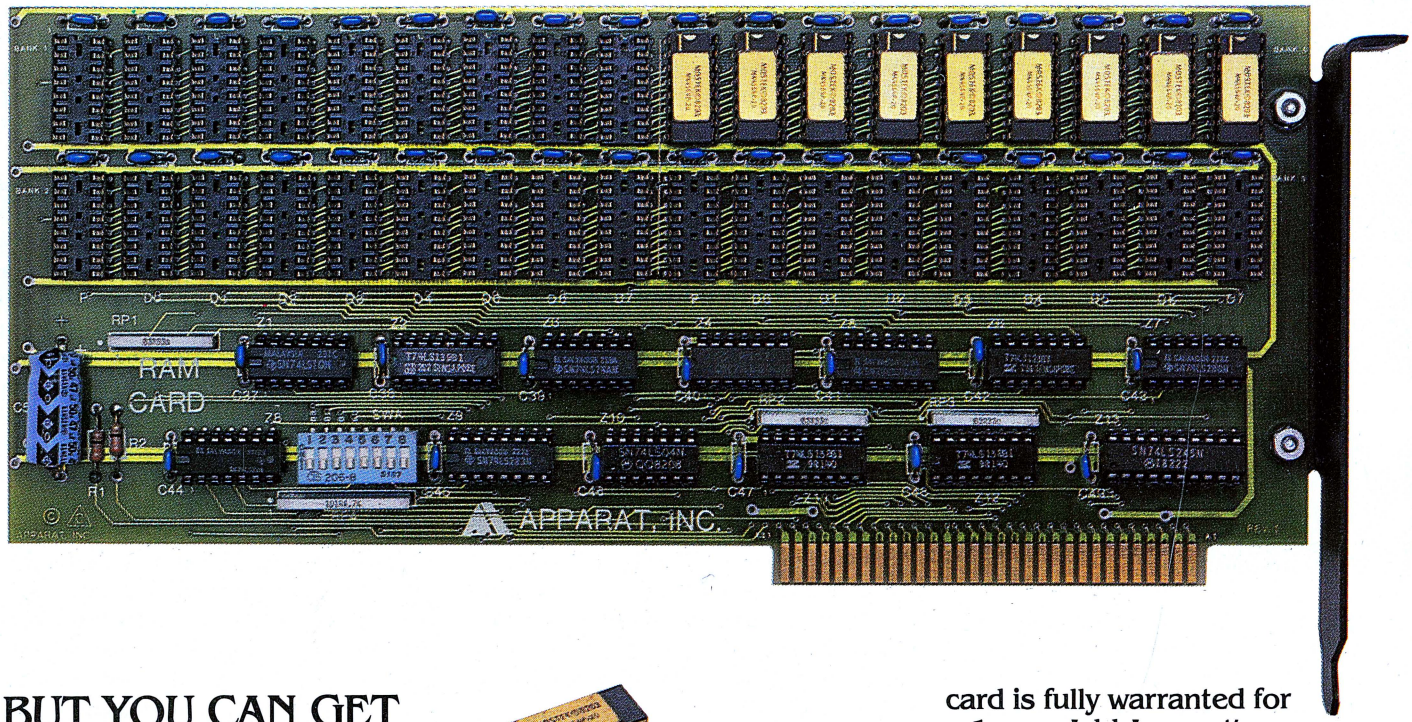

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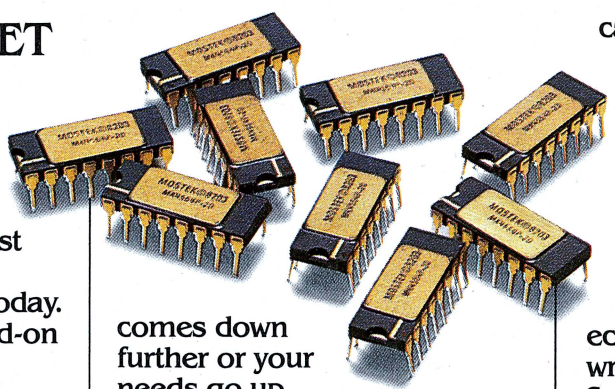

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print# statement with a semicolon to keep Basic from adding carriage returns at the ends of print lines, and we set the printer width to 255 to keep Basic from periodically inserting even more carriage returns and line feeds. The number 255 is special, in that it switches off those extra control characters. Notice how careful we must be to tell Basic not to do too much for us!

Lines 320 through 340 reset the printer to its power-up state, set the vertical line spacing to match the spacing of the eight firing pins, and set the tab position. Each of these lines begins with the escape character, *chr$(27)*, which is used to signal to the printer that a special control code is coming. Some control codes, those that cannot be confused with ordinary text, are not preceded by the escape character. An example is the tab control, *chr$(9)*, in line 370.

Line 360 begins the loop over the columns of pels. Since the buffer contents are fetched one byte at a time, each pass through the loop corresponds to four columns of medium-resolution pels, or eight columns of high-resolution pels. The loop is executed eighty times because there are eighty bytes of buffer per row.

Line 380 tells the printer how many characters of graphics information will be sent. This command must be sent to the printer immediately before each row of graphics information. The last two characters in line 380, *chr$(144)chr$(1)*, indicate that 144+1X256, or four hundred, characters of graphics information will be sent. After the printer receives four hundred characters, it will automatically switch out of graphics mode.

The printed result is rotated ninety degrees relative to the screen. The rotation is dictated by the fact that the screen is represented in the buffer in rows of pels, rather than columns, whereas the pins on the print head are vertically oriented. To create an unrotated picture would require rearranging the bits before sending them to the printer.

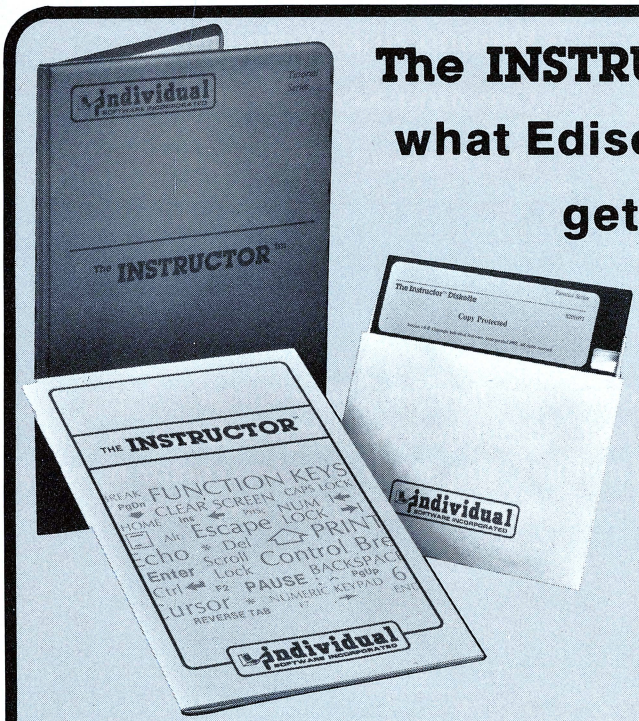
To create the rotated image, we can begin at the lower-left corner or at the upper-right corner of the screen. Our example begins at the lower-left corner. Thus, each column of pels is sent, beginning at the bottom of the screen. Since there are one hundred even-numbered rows, with eighty bytes per row, the last row begins at address 99X80, or 7920—the number appearing in line 390.

Line 400 begins a loop over the one hundred even-numbered and one hundred odd-numbered pel rows. The buffer contents are fetched in line 410 and sent to the printer in line 420. Each byte is sent twice so the printed image will have a good length-to-width ratio. In line 430, the buffer address is decremented by eighty to skip the preceding even-numbered pel row.

After each row of pels is sent to the printer, a carriage return and line feed are sent, from line 450. A carriage return and page advance in line 470 end the screen dump.

Wrapping It Up. The color graphics adapter is a very flexible hardware option for the IBM pc. In some of the IBM documentation, a slash is included in the name *color/graphics*, emphasizing that those two features need not go together. After all, the adapter can be used for forty-column or eighty-column color text and high-resolution black-and-white graphics, as well as for medium-resolution color graphics.

We saw that IBM Basic provides a comprehensive set of instructions for controlling the graphics screen. Occasionally, however, it is easier or quicker to access the display buffer directly, by means of *poke* and *peek*. Since *poke* and *peek* act on entire bytes, this method allows us to operate on several pels at once. The examples show how easy that is to do. These techniques could also be used to construct more complex graphics in any language that does not have the powerful graphics instructions provided in Basic. ▲



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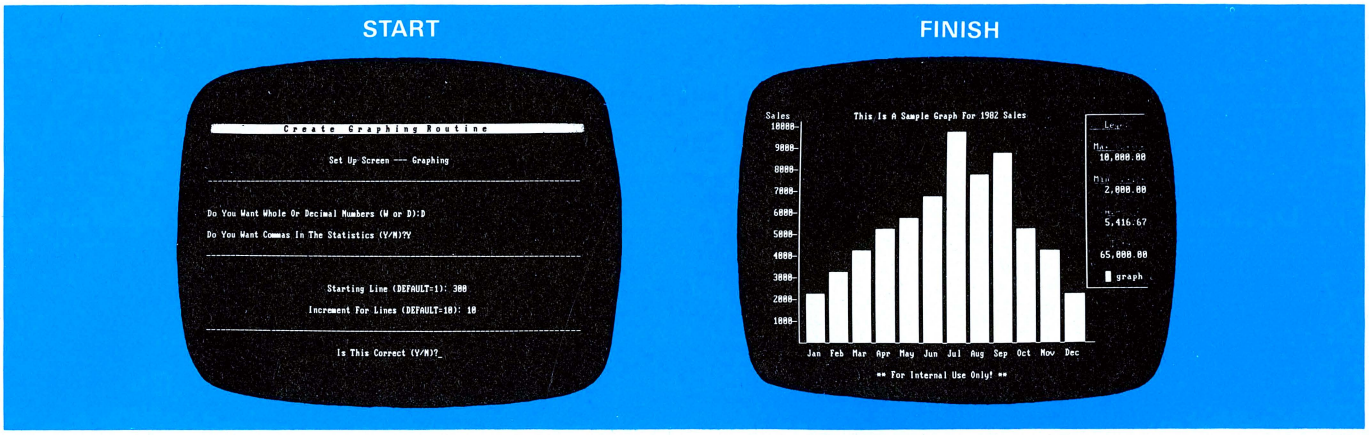

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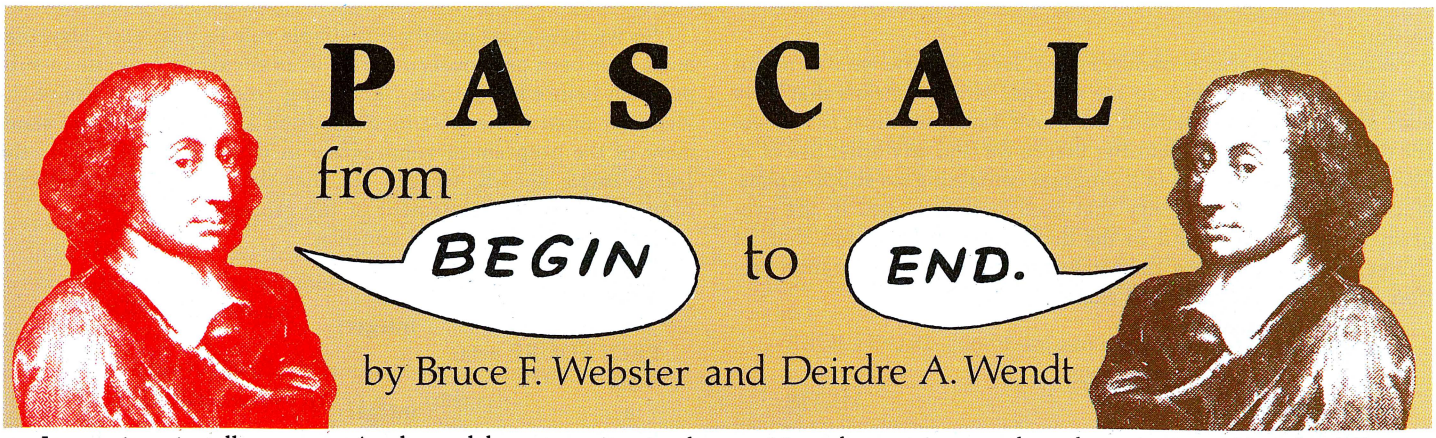


by Bruce F. Webster and Deirdre A. Wendt

In previous installments, you've learned how to write simple Pascal programs. Period. True, you've learned all about enumerated data types, Boolean expressions, flow-of-control structures, and other esoterica. But the fact remains that all you can do is write one big program that starts at *begin* and finishes at *end*. If you have a set of commands that you want to use in five different places, then you have to write that code in all five places. (Of course, if you merely want to execute the same code five times in a row, you can put it in a *for* loop.)

Here the limitation ends. The next two columns will discuss the use of *procedures* and *functions*, which together are known as *subprograms*. In this column, you'll first hear about the general concept of a subprogram. You'll then see how (and where) to place subprograms in your main program. We'll then touch on the idea of *scope*, which governs where a subprogram may be called. We'll end with a discussion of *parameters* for subprograms, and you'll get a taste of some of the different things you can do with them.

Subprograms. As you've learned in previous columns, a Pascal program has the following structures:

```
PROGRAM whatever;
< declaration section >
BEGIN
   < program statements >
END. (* of PROGRAM whatever *)
```

To repeat, you can get by with just this for small programs, but you'll find it very limiting with big ones, especially if you have sections of code repeated at various places in the program.

The solution? Pascal allows you to create subprograms. A subprogram is indeed like a miniature program contained within a larger one. Here, for example, is the structure for defining a procedure (one of two types of subprograms):

```
PROCEDURE whichever;
< declaration section >
BEGIN
   < procedure statements >
END; (* of PROCEDURE whichever *)
```

Look familiar? The only visible differences between this format and that for a program are that the word *procedure* is used and that the *end* is followed by a semicolon instead of a period. (A few other differences will crop up later.) As with a program, execution starts right after the *begin* statement and finishes at the *end* statement.

The next question is, where do you put subprograms in your program? Answer: after the declaration section and before the opening *begin* of your program. Indeed, you can think of your subprograms as being the last part of your declaration section (after all of your *const*, *type*, and *var* statements).

Some of you may then wonder if you can declare a subprogram within a subprogram. Yes, you can, just as you would in a regular program. And you could declare subprograms within *that* subprogram, and so on, ad infinitum (well, not quite, each compiler has its limits).

Now that you've got the subprogram in place, the following question is, how do you use it? Answer: simply by stating its name. Let's put our procedure within our program and call it a few times:

```
PROGRAM whatever;
CONST
   maximum              = 10;
TYPE
   crange               = 0..maximum;
VAR
   indx                 : crange;
PROCEDURE whichever;
CONST
   star                 = '*';
TYPE
   days                 = (mon,tues,wed,thurs,fri,sat,sun);
VAR
   day                  : days;
BEGIN (* of main body of PROC whichever *)
   FOR day := mon TO fri
      DO write(star)
END; (* of PROC whichever *)
BEGIN (* of main body of PROGRAM whatever *)
   FOR indx := 0 TO maximum DO BEGIN
      whichever;
      writeln
   END
END. (* of PROG whatever *)
```

In this example, we've deliberately included *const*, *type*, and *var* statements in both the main program and the subprogram so that you won't be confused about *where* subprograms go, and so you can see how similar the two structures are. Look over the example carefully and see if you can figure out just what it will do. In case you're not sure, we'll explain that *write* and *writeln* are built-in procedures (they're always there; you don't have to define them). *Write(star)* will print an asterisk on the screen, while *writeln* will start a new line.

Finished? If you guessed that this program would print out eleven lines, each consisting of five asterisks (*****), you're right.

Scope. Before we can go any farther into the intricacies of subprograms, we must first deal with the concept of *scope*. In a Basic program, all identifiers (variables, functions, line numbers) are *global* in scope. In other words, any identifier can be referenced from anywhere in the program. Indeed, any identifier can be declared anywhere in the program, and variables are declared merely by referring to them.

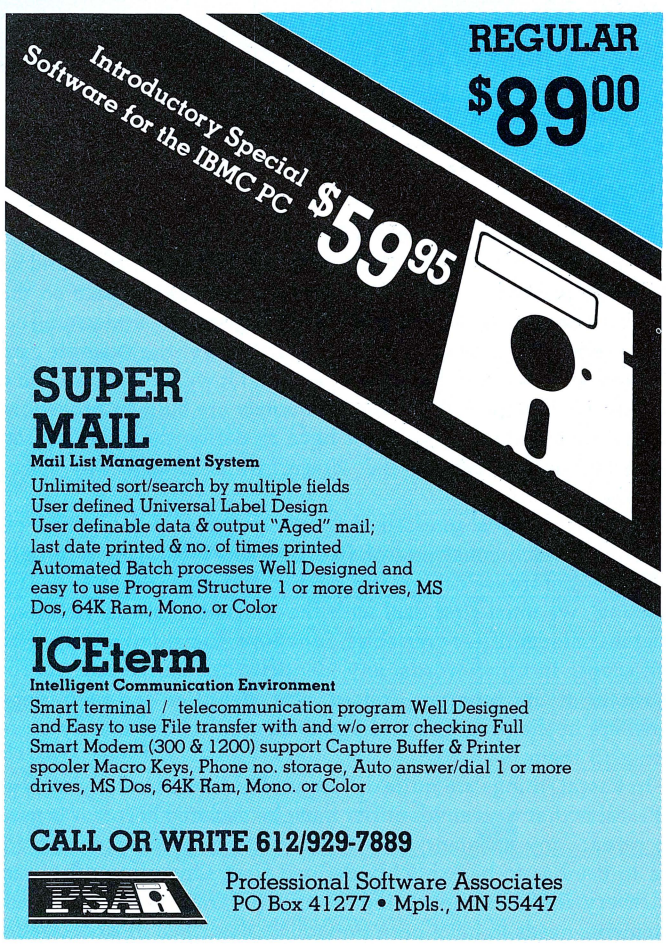
In Pascal, things are quite different. The Great Underlying Rule of Pascal is that a given identifier must be declared before it is used. We repeat: any constant, data type, variable, or subprogram you care to use has to be explicitly defined first. One more time: each and every identifier appearing in any program (or subprogram) statements needs to have been previously described in a declaration

section.

Having made that pronouncement, let's see now what is meant by "previously declared." In the simplest sense, it means that if we start at the *program* statement and move down, we must run across the declaration of each identifier before we find any other use of it. We can easily check that in a program containing no subprograms, since we need only to verify that each identifier used in the program statements is found in the declaration section (and that, of course, we are following the same rule within the declaration section itself). But consider this example:

```
PROGRAM scope1;
VAR
  a                    : integer;
PROCEDURE setb;
VAR
  b                    : integer;
BEGIN
  b := 2*a;
END; (* of PROC setb *)
BEGIN (* main body of PROG scope1 *)
  a := 2;
  setb;
  writeln(a+b)
END. (* of PROG scope1 *)
```

Here, our simple rule has been met; both *a* and *b* have been defined as being variables of type *integer* before being used—and yet this program will not compile. Why? Because *b*, having been declared in the procedure *setb*, is recognized only within that procedure. In other words, the variable *b* is *local* to the procedure *setb*. By contrast, the variable *a* is recognized both within *setb* and in the main program itself.



So we now must modify our simple rule to this: each identifier must have been previously declared in an enclosing program or subprogram before being used. "Enclosing" means that the use of the identifier must come after its declaration and before the *end* statement of the program or subprogram in which it is defined. In the last example shown, we can see that the statement *writeln(a+b)* comes after the *end* statement of the procedure *setb*.

Here's one final case to consider:

```
PROGRAM scope2;
VAR
  a                    : integer;
PROCEDURE seta;
VAR
  a                    : integer;
BEGIN
  a := 4
END; (* of PROC seta *)
BEGIN (* main body of PROGRAM scope2 *)
  a := 3;
  seta;
  writeln(a)
END. (* of PROG scope2 *)
```

Two questions: Will this program compile? And if it does, what value will it print out?

Two answers: yes and 3.

This brings up a corollary to our rule: the most recent declaration of a given identifier will always be used. The procedure *seta* set its own local variable *a* to 4 and left the global variable *a* untouched.

An editorial comment. Those of you used to Basic or Fortran may chafe at this discipline that Pascal requires of you. After all, it's so nice to make up variables as you go along. However, an excellent reason for these restrictions exists. There are two great sources of program bugs in Basic and Fortran: misspelled variables and side effects.

It is not uncommon to type *index* in one statement and *indx* in another and have the program merrily go on its way. It is also not unusual to use the same variable (unknowingly) in several different parts of the program, often with bizarre results (especially if those sections call one another). Pascal takes great strides towards eliminating these bugs. You can still create them, it is true, but you have to really work at it.

Parameters. Perhaps the most common use of subprograms is to perform the same set of operations using different sets of values. For example, you might want a procedure that swaps two integer values. Which two values should it swap? One solution is this:

```
PROGRAM testswap;
VAR
  s1,s2,alpha,bravo,charlie,delta,eagle,foxtrot  : integer;
PROCEDURE swap;
VAR
  temp                 : integer;
BEGIN
  temp := s1;
  s1 := s2;
  s2 := temp
END; (* of PROC swap *)
BEGIN (* main body of PROGRAM testswap *)
  alpha := 1; bravo := 2; charlie := 3;
  delta := 4; eagle := 5; foxtrot := 6;
  s1 := alpha; s2 := eagle;
  swap;
  alpha := s1; eagle := s2;
  s1 := bravo; s2 := delta;
  swap;
  bravo := s1; delta := s2;
```

```
    s1 := charlie; s2 := foxtrot;
    swap;
    charlie := s1; foxtrot := s2
  END. (* of PROG swaptest *)
```

Now, a little thought will show just what a lousy approach this is. We are executing more statements before and after each call to *swap* than we would if we just did each swap directly. Luckily, we don't really have to do this. Instead, we can define *swap* as having a list of *parameters*. For example:

```
PROGRAM testswap;
VAR
  alpha,bravo,charlie,delta,eagle,foxtrot : integer;
PROCEDURE swap(VAR s1,s2 : integer);
VAR
  temp                    : integer;
BEGIN
  temp := s1;
  s1 := s2;
  s2 := temp
END; (* of PROC swap *)
BEGIN (* main body of PROGRAM testswap *)
  alpha := 1; bravo := 2; charlie := 3;
  delta := 4; eagle := 5; foxtrot := 6;
  swap(alpha,eagle);
  swap(bravo,delta);
  swap(charlie,foxtrot)
END. (* of PROG testswap *)
```

A lot better, no? The integer variables *s1* and *s2* are no longer global variables but instead are *parameters* of the procedure *swap*. Each time *swap* is called, the actual variables in the call (say, *alpha* and *eagle*) are used in place of *s1* and *s2*. Because of this, *s1* and *s2* are called *formal* or *dummy parameters*, while *alpha* and *eagle* are known as *actual parameters*.

There is one other twist in parameter lists. The prefix *var* before any formal parameter means that the corresponding actual parameter is directly substituted for the formal parameter. In other words, if the formal parameter has its value changed, the actual parameter also changes. If there is no *var* prefix, the actual parameter cannot be affected by anything that happens to the formal parameter. For example, here's a procedure that forces a variable to be within two values:

```
PROCEDURE condition(min : integer; VAR val : integer;
                    max : integer);
BEGIN
  IF min > max
    THEN swap(min,max);
  IF val < min
    THEN val := min
  ELSE IF val > max
    THEN val := max
END; (* of PROC condition *)
```

Why do we want to have formal parameters that do not return values? Well, if we make the call condition(20,alpha,0), we don't want the procedure to return a value to the constants *20* and *0*, and, indeed, Pascal would not let us. If we defined *condition* with the parameter list (*var min,val,max : integer*), we would get a compiler error with the above call. Why? Because the compiler knows that it cannot return a value to a constant or an expression, but only to a variable.

Next month, we'll continue our discussion of parameters, along with functions, recursive calls, forward declarations, and anything else we can think up. ▲

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THE PROFIT PLOT

by Jack Grushcow

We hope last month's article has all the retailers out there anxious to learn how to apply the *retail inventory method* (RIM) to their businesses.

If you're not a retailer but are interested in other spreadsheet applications, return the questionnaire from last month's *Softalk* and tell us what you'd like to see in future columns. If you don't have that issue, just drop *Softalk* a line and let us know your application interests.

Last month we gave you an overview of a series of interrelated spreadsheets comprising the *retail inventory method*, a spreadsheet system designed to help retailers improve gross profit margins. This month you'll learn how to build and use the spreadsheets needed to apply the RIM to your business.

To see how these spreadsheets are used, we'll look over the shoulder of a shoe retailer. Our fictitious company is the Adams Shoe Barn.

The spreadsheet principles apply to any commodity, of course. Whether you sell hardware, bean sprouts, sporting goods, or microcomputers, the RIM system application is the same. The idea is to sell your

Jack Grushcow is president of Consumers Software Incorporated, a company that designs and markets spreadsheet-based business packages. His latest book, The VisiCalc Applications Book, *is available from Reston Publishing. This article is based on ideas contained in that book.*

```
      A          B                C
1             FORMULA ROW>/FR
2
3             MONTHLY          /FRRECEIVING
4             /-*              /-*
5
6   /FRFOR:
7
8   DATE      SUPPLIER         /FLINVOICE#
9   /--       /RA9.A9:B9.H9
10
11  /--       /RA11.A11:B11.H11
12  TOTAL     /--              /--
13  /--       /RA13.A13:B13.H13
```

```
      A          B                C
1             "FORMULA ROW
2
3             "MONTHLY         "RECEIVING
4             '*CR
5
6   "FOR:
7
8   "DATE     "SUPPLIER        "INVOICE#
9   '-
10
11  '-
12  "TOTAL:          '-
13  '-
```

```
FORMULA ROW >
MONTHLY    RECEIVING    SHEET
*********************************
FOR:
DATE        SUPPLIER          INVOICE#
-----------------------------------------
-----------------------------------------
TOTAL:      ---------------------------
-----------------------------------------
```


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Each spreadsheet uses the *packed model format*. Because all the formulas and formats already are in place, anyone can enter the data; your staff can learn to use the RIM system in minutes. As you'll see, this design is much more flexible and powerful than the usual fill-in-the-blank template approach.

The Receiving Sheet. The first spreadsheet in the RIM system is the *receiving sheet*. Figures 1 and 2 show the keystrokes to build it, using either *VisiCalc* or *SuperCalc*. Turn on your pc and build the model; you'll learn more from using the RIM system than you will by just reading about it. After typing the keystrokes, compare your model to figure 3.

Now, before learning how to use the receiving sheet, let's review exactly what it will do.

The receiving sheet is a record of all stock received during the month. As each shipment arrives, you record the date it was received, the supplier's name and invoice number, the landed cost, retail value, and markup percentage.

The receiving sheet is an inventory barometer. All inventory increases appear in this spreadsheet, as well as supplier returns, supplier credits, and any additional markups. At the end of the month, you'll know exactly how the cost and retail value of in-

D	E	F	G	H
F$	/F$	/F$+E1+D1	/F$+F1/(1−H1)	/F$(G1−F1)/G1
FRSHEET				
−*				
FLINVOICE COST	/FRTRANSPORTATION	/FRLANDED COST	/FRRETAIL	/FRMARKUP
SUM(D9.D11)	/RD12.D12:E12.G12RR			+G12−F12/G12

Figure 1.

D	E	F	G	H	I
		+E1−D1	+F1/(1−H1)	/FG$(G1−F1)/G1	
"SHEET					
	'CR				
"INVOICE COST	"TRANSPORTATION	"LANDED COST	"RETAIL	"MARKUP	
					'CR
SUM(D9.D11)	SUM(E9.E11)	SUM(F9.F11)	SUM(G9.G11)	(G12−F12)/G12	'CR
					'CR

Figure 2.

			0.00	ERROR	ERROR
	INVOICE COST	TRANSPORTATION	LANDED COST	RETAIL	MARKUP
	0.00	0.00	0.00	0.00	ERROR

Figure 3.

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ventory have changed. Later, you'll use these figures in the monthly margin budget and to help track total inventory value.

The receiving sheet also shows the markup on each item; you can quickly spot declining supplier margins or lines of goods inappropriately priced.

Now that we know why we use this spreadsheet, let's look at how.

New stock is delivered to Adams Shoe Barn throughout the month. An entry line is inserted into the receiving sheet for every delivery.

Let's suppose that Adams started using the RIM system in January. Move your cursor to B6, opposite the label **FOR:**, type **JANUARY**, and enter.

The top line of the spreadsheet is the formula row, containing all the formulas and formats to make the spreadsheet work. Each time you enter new information, you must first insert a row with the **/IR** command, and then replicate the formula row into it with the **/R** command. This is the essence of the packed model concept. To use the RIM system, you need only know two spreadsheet commands and how to move the cursor.

Back to Adams. On January 3, he receives twelve pairs of men's running shoes from the Jones Shoe Co., invoice #LL510. The total cost is $140, plus $20 shipping charges, and Adams pegs the shipment's retail value at $225.

We'll use row 10, currently empty, for the entry. First, however, you must replicate the formula row into it. *VisiCalc* users do this by moving the Cursor to C1, typing

/R.H1

and pressing enter. Now move the cursor down column C to row 10, press enter again, and type

RRRRRRR

SuperCalc users will replicate the formula row by moving the cursor to C1, typing

/R C1:H1,

and pressing the escape key. Now move the cursor down column C to row 10 and press the enter key. (Incidentally, *SuperCalc* users, your manual will tell you how to build an execute file to do this replication automatically, and it's worth the effort to learn this powerful command.)

Now let's enter Adams's shipment in the appropriate cells: **Jan 3** in A10, **Jones Shoe Co.** in B10, **LL510** in C10, **140** in D10, **20** in E10, and **225** in G10. Landed cost and markup are calculated automatically.

Let's examine the spreadsheet's last two columns—**RETAIL** and **MARKUP**. How retail prices are determined varies from one business to another, even one product line to another. Some retailers use the suppliers' "suggested" retail prices. Adams, for example, may use his supplier's suggested retail prices because they've proven reliable. If that's how you value inventory, enter a retail value on the receiving sheet and the markup percentage will be calculated for you.

Conversely, some suppliers' suggested retail prices aren't realistic. Perhaps they expect larger orders because of the greater margin or maybe they're misreading the market.

In any case, the RIM reveals how accurately your suppliers are pricing their goods.

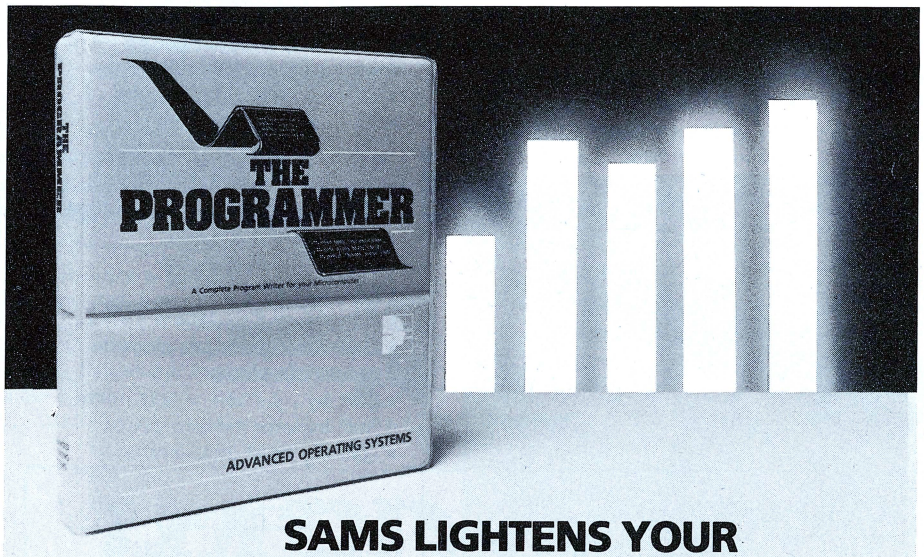
Certain goods may warrant a special markup. Adams, for example, has a proportionately higher markup on his high-fashion shoe lines. If you prefer pricing a shipment with a desired percentage markup rather than a retail value, put your figure in column H; the retail value is calculated automatically.

Let's Illustrate. On January 4, the Shoe Barn receives six pairs of high-fashion pumps from Paris Shoes, invoice #PS-101. The cost of the shipment is $325 and the supplier paid for the shipping. Adams decides to mark up this shipment by 58 percent.

Our spreadsheet is full, so we have to insert a new row. Move your cursor into row 11 and type

/IR

(*SuperCalc* users must then press the enter key.) Before entering the new information,



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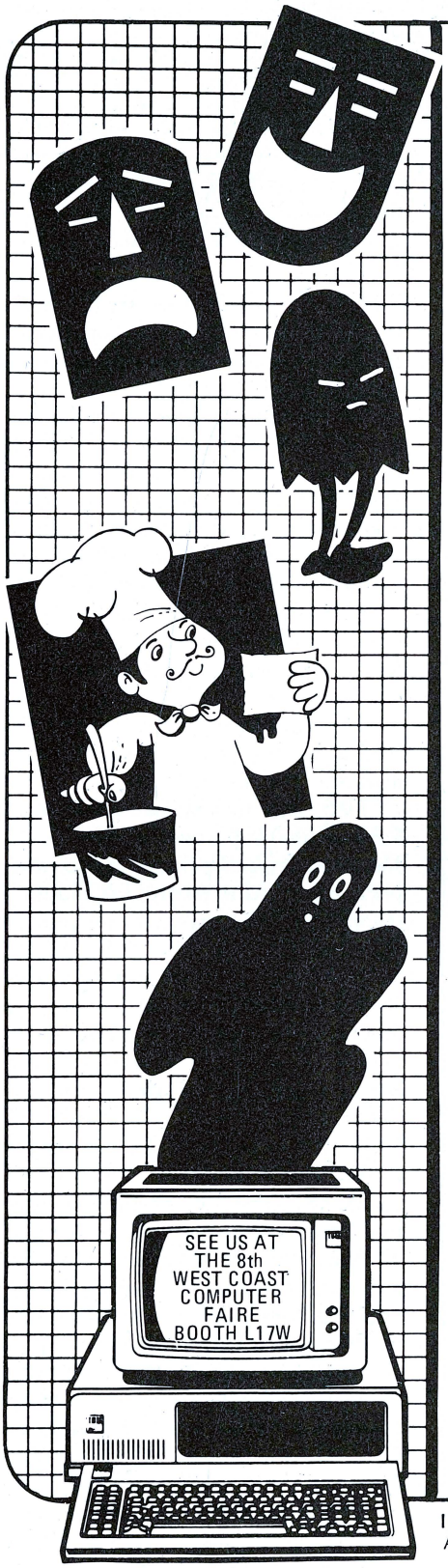

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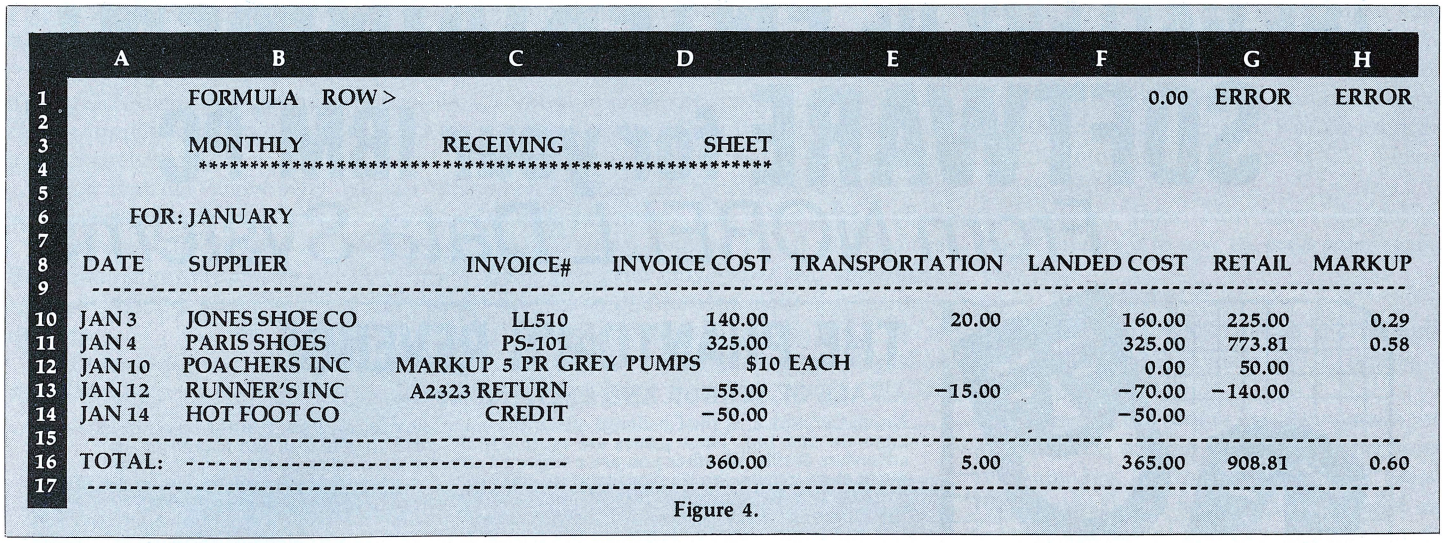

	A	B	C	D	E	F	G	H
1		FORMULA ROW>				0.00	ERROR	ERROR
2								
3		MONTHLY	RECEIVING	SHEET				
4		**********	**********	**********				
5								
6	FOR: JANUARY							
7								
8	DATE	SUPPLIER	INVOICE#	INVOICE COST	TRANSPORTATION	LANDED COST	RETAIL	MARKUP
9								
10	JAN 3	JONES SHOE CO	LL510	140.00	20.00	160.00	225.00	0.29
11	JAN 4	PARIS SHOES	PS-101	325.00		325.00	773.81	0.58
12	JAN 10	POACHERS INC	MARKUP 5 PR GREY PUMPS	$10 EACH		0.00	50.00	
13	JAN 12	RUNNER'S INC	A2323 RETURN	-55.00	-15.00	-70.00	-140.00	
14	JAN 14	HOT FOOT CO	CREDIT	-50.00		-50.00		
15								
16	TOTAL:			360.00	5.00	365.00	908.81	0.60
17								

Figure 4.

you'll have to replicate the formula row into row 11. Again, *VisiCalc* users will move the cursor to C1, type

/R.H1

and enter. Now move the cursor down column C to row 11, press the enter key, and type

RRRRRRR

SuperCalc users will replicate the formula row by moving the cursor to C1, typing

/R C1:H1

and then pressing the escape key. Then move your cursor down column C to row 11 and press enter.

Now you'll record the shipment information in the appropriate cells: **Jan 4** in A11, **Paris Shoes** in B11, **PS-101** in C11, **325** in D11, and **.58** in H11.

As you can see, whichever way you set retail price, the receiving sheet shows both a retail value and a markup percentage. If you want to know what the retail price is if you increase the markup percentage, or how markup changes retail price, the receiving sheet shows you. Simply vary the markup to see the effect on retail price, or vary the retail price to see how markup percentage is affected.

You must enter either a retail value or a markup percentage for each shipment. When you enter a value in either the **MARKUP** or the **RETAIL** column, you overwrite the formula in that column. That's okay; we only need one of the two formulas. One allows the other to be calculated.

Be sure to record all transactions that affect the value of your inventory. We'll use this information to figure the monthly total inventory value.

Three other types of transactions are recorded on the receiving sheet: additional markups, returns, and supplier credits.

First, let's look at additional markups. Suppose that a product is in short supply. Increased demand permits you to raise your price. You need to record this additional retail value of your inventory on your receiving sheet.

For example, on January 10 the federal government bans the importation of products using the hides of endangered species. Ever the opportunist, Adams adds ten dollars to the price of his last five pairs of gray elephant-skin pumps.

To enter this markup, move your cursor to A12 and insert a new row with the **/IR** command. Replicate the formula row into row 12 the same way you did for row 11.

Now enter the information into the appropriate cells. The date goes in A12; in B12, type **Poachers Inc.** Since labels have no calculation value, you can use columns C, D, and E to record the description of your additional markup. Type **markup 5 pr** in C12, **gray pumps** in D12, and **"$10 ea** in E12. In G12, enter **50**. Because the markup formula doesn't apply to added markups, delete the formula in H12 with the **/B** command.

The next transaction affecting inven-

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tory value is returns to suppliers. When you return goods, you should subtract their value from inventory both at retail and cost. On January 12, for example, Adams received a large shipment of women's jogging shoes from Runners Inc., invoice #A2323. Four pairs, with a retail value of $140, had defective soles. Adams's cost for the four defective pairs was $55, plus $15 for shipping.

Again, insert a new row at row 13, replicate the formula row into it, and enter the shipment information into the appropriate cells. At C13, type **A2323 return** to clarify the transaction. Enter **−55** at D13, **−15** at E13, and **−140** at G13. The figures are entered as negative numbers because returned stock reduces both the cost and retail value of your inventory. Since markup doesn't apply in this case, erase the formula at H13 with the **/B** command.

The final type of transaction recorded in the receiving sheet is a supplier credit, which you may receive for an incorrect bill, a special discount, a supplier promotion, and so forth. On the receiving sheet, a credit reduces only the cost of your inventory.

Let's see how Adams handles it. On January 14, he received a $50 credit from the Hot Foot Co., because of an incorrect charge on a previous invoice.

Insert a new line at row 14, replicate the formula row into it, and enter the date and supplier in the appropriate cells. At C14, type **credit** to clarify the transaction, and at D14, enter **−50**. Erase the formulas at G14 and H14 with the **/B** command.

That's all there is to it. You've entered the four types of transactions recorded on the receiving sheet. To confirm your entries, compare your spreadsheet to figure 4.

If you remember to record all additions and reductions to your inventory value each month, both at cost and at retail, you'll see the total change for the month in the **TOTAL:** line at the bottom of the spreadsheet. The RIM will use those totals to keep you up to date on your inventory value.

Now, save your spreadsheet if you built the receiving sheet model, and let's look at the second spreadsheet in the RIM system.

Using the Discount Sheet. The next step in the RIM system deals with controlling discounts. Your screen should be clear, so follow the keystrokes in figures 5 or 6 to build the model. When you've finished, compare it to figure 7.

The discount sheet keeps a running total of the amount you've discounted your inventory because of clearances, sales, and other price reductions. Your skill as a retailer is revealed on your discount sheet because how much an inventory is discounted tells how well you are purchasing and pricing your inventory. It's your scorecard.

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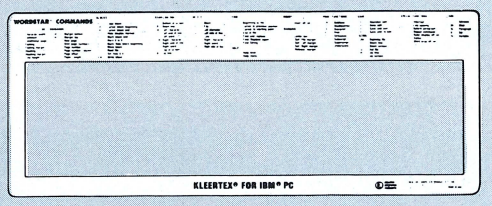

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	A	B	C	D	E	F	G	H	I
1		FORMULA ROW >/FL			/F$	/F$	/F$+E1−F1	/F$+G1*C1	
2									
3					/FLDISCOUNT	REGISTER			
4					/−*	/−*			
5									
6	/FRFOR:								
7					/FROLD	/FRNEW			
8	/FLDATE	ITEM	/FLQUANTITY	/FRSUPPLIER	/FRPRICE	/FRPRICE	/FRDIFFERENCE	/FREXTENSION	/FRCOMMENTS
9	/--	/RA9.A9:B9.I9							
10									
11	/--	/RA11.A11:B11.I11							
12	TOTAL:	/--	/RB12.B12:C12.G12					/F$@SUM(H9.H11)	
13	/--	/RA13.A13:B13.I13							

Figure 5.

	A	B	C	D	E	F	G	H	I
1		"FORMULA ROW				+E1−D1	+F1/(1−H1)	/FG$(G1−F1)/G1	
2									
3					"DISCOUNT	"REGISTER			
4					'*		'CR		
5									
6	"FOR:								
7					"OLD	"NEW			
8	"DATE	"ITEM	"QUANTITY	"SUPPLIER	"PRICE	"PRICE	"DIFFERENCE	"EXTENSION	"COMMENTS
9	'−								'CR
10									
11	'−								'CR
12	"TOTAL:	'−						SUM(H9.H11)	
13	'−								'CR

Figure 6.

types of transactions. The more common one is the discounting of existing stock. The other one records when you restore discounted stock to regular price.

Sometime during happy hour at the shoe dealers' trade show in Detroit, Adams orders three pairs of simulated, red lizard-skin pumps. Well, live and learn. On January 10, he decides to clear this stock out of the store to make room for new inventory.

Adams marks down the three pairs of shoes, originally priced at $110, to $60. Row 10 is empty, so replicate the formula row (row 1) into it the same way you did on the receiving sheet. To record the discount, enter the information into the appropriate cells, starting with the date at A10. At B10, type **red lizard pumps** and record the quantity in C10. The supplier was Artistic Shoes. Record the old price and the new price; the price difference and the decreased inventory value due to this markdown are calculated automatically.

On January 11, Adams decides that the Shoe Barn looks like a bargain basement because so many items are on sale. He marks back up to regular price the five pairs of hiking boots that were on special.

As before, insert a new row on your spreadsheet and replicate the formula row into it. To cancel the discount, enter your information into the appropriate cells. The supplier was Wild Boots Inc. The old price was $50 and the new price is $65.

The discount spreadsheet automatically records the canceled markdown by showing a decreased inventory value.

Keep your discount sheet current and at month's end the figure in the **TOTAL** line under the **EXTENSION** column will show how discounts affected your inventory value.

Also, since the discount sheet provides a detailed record of the discounts each supplier was responsible for, you'll know which suppliers contribute to your profits and which habitually sell you goods that end up in your discount bin.

Let's get back to the big RIM picture. Keep your discount sheet current and you'll have a record of all the stock discounted during the month. This information will help track your gross margin. We'll tell you how in a future article.

Next month, we'll complete the three remaining spreadsheets in the RIM system and examine how this system can increase your retail profits. ▲

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```
                FORMULA ROW >                                                  0.00          0.00
                                        DISCOUNT  REGISTER
                                  ******************************************************
          FOR:
                                                          OLD     NEW
DATE            ITEM                QUANTITY    SUPPLIER  PRICE   PRICE   DIFFERENCE  EXTENSION   COMMENTS
-----------------------------------------------------------------------------------------------------------------

-----------------------------------------------------------------------------------------------------------------
TOTAL:          ------------------------------------------------------------------------------------  0.00
-----------------------------------------------------------------------------------------------------------------
```

Figure 7.

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SYSTEM NOTEBOOK

by Alan Boyd

Files fall into two general categories, according to whether they hold programs or data. All information, whether program or data, is stored in units called bytes, each of which consists of eight binary digits (zeros or ones). A single byte can hold any of 256 values, since two to the power of eight is 256.

A program is a set of numbers the computer can interpret as commands to perform specific actions. Instructions vary in length; most require two or more bytes of information.

ASCII and EBCDIC. Data, as distinguished from program information, consists of information that programs access, manipulate, and store. This type of information is stored by means of a code, in which each value between 0 and 255 represents some specific alphanumeric symbol. A number of coding schemes have been invented, the most widely accepted of which is called ASCII (American Standard Code for Information Interchange). ASCII is used almost universally as a method of representing information digitally. The only serious challenge to the ASCII standard is EBCDIC (pronounced *ebb-see-dick*), propagated by none other than IBM itself.

EBCDIC (Extended Binary-Coded Decimal Interchange Code) is the standard method used to represent data digitally in IBM mainframe computers. Several years ago there was a raging debate about which of the two codes would become standard. ASCII won out by gaining government and standards committee approval; IBM didn't change its systems, however, because the changeover would have been almost impossible, given the magnitude of the job.

Luckily for us, IBM did not use EBCDIC on the Personal Computer. Communications with mainframe computers (including those not supplied by IBM) and with other personal computers seemed imperative to the success of the pc, so IBM decided to go with ASCII instead. Actually, the process of converting data from ASCII format to EBCDIC and back is a relatively trivial assignment for a computer as sophisticated as the pc, so no inherent limitation on the power of the machine was imposed by the selection of ASCII.

Many of the most common types of DOS files contain ASCII representations of data. For example, as we saw earlier, it's possible in DOS to redirect the input and output streams to locations other than their normal destinations. This allows us to type characters directly from the keyboard into a DOS file (by issuing the command *copy con: filespec*; see the discussion of batch files in the October 1982 installment of this column). The file created by this procedure contains the ASCII representations of the characters typed.

The best way to tell if a file contains ASCII information is to type its contents on-screen, by means of the *type* command. If the file is legible, it contains ASCII. If it appears as gibberish, it's most likely a program file.

Some files may appear as a combination of understandable English words and gibberish. This is because some programs include ASCII-encoded messages that are to appear on-screen; the files in which these programs are stored are of a hybrid type, containing both program data and ASCII text.

Most non-ASCII files contain programs. You may have noticed earlier in this series that there are two distinct types of external DOS command files— com files and .exe files. There's a reason for this differentiation of external command files; it has to do with the nature of the Intel 8088 microprocessor that sits at the heart of the pc.

The Intel 8086 family of microprocessors, of which the 8088 is a member, addresses memory locations by means of *segmentation*—a technique familiar to those who have worked at the systems level of a mainframe computer. This technique imposes some restrictions on the way programs relate to memory; it also somewhat artificially limits the amount of memory that can be used.

Magic Numbers. The segmentation approach accounts for the fact that there are several "magic" numbers, such as 64K, associated with the performance of some software. Perhaps a review of the microprocessor architecture will help explain the significance of these numbers.

You're probably aware that the 8088 microprocessor can address up to a megabyte (approximately a million bytes) of memory. That's the first magic number. The actual number of memory locations that can be used is the equivalent of two to the power of twenty, or 1,048,576.

The second magic number is sixteen, because the 8088 is a sixteen-bit microprocessor. What makes the 8088 a sixteen-bit processor is the fact that it contains a number of internal registers that are sixteen bits wide. One of the prime functions of these registers is the manipulation of sixteen-bit numbers for memory-addressing purposes; such numbers are used, for example, as pointers to data tables. Two to the power of sixteen is 65,536, usually abbreviated 64K; 64K is our third magic number.

The 8088 is designed to work with both eight-bit and sixteen-bit data, but it internally performs sixteen-bit arithmetic operations. Therefore, when it calculates addresses it can work only with sixteen-bit-long addresses. Additional calculations and memory manipulation are required in order for the 8088 to address the larger memory available.

Memory is therefore divided into *segments* of 64K. The 8088 can work directly with only four of these segments at one time. The predefined uses for the four available segments are as *code segment, data segment, stack segment,* and *extra segment*. However, the microcomputer industry at large is still used to writing software for eight-bit architectures. In the eight-bit world, the entire code—program, stack, and whatever "extra" may be in the program—is expected to coexist within one 64K segment. You'll find that most of the commercially available programs that work only within a 64K limit have had their roots in the eight-bit world.

Of course, the decision as to whether or not to cram all the functions of a computer program into one 64K segment is left entirely to the programmer. Although many of the development tools available for the pc programmer are capable of working with the full one-megabyte address space, many programmers restrict their work to a

single 64K segment. Why is this?

One of the most convincing arguments for restricting a program to a single segment is that it may be inappropriate for such a program to work in a larger space. The most striking example of this type of program is the Basic language interpreter supplied with the pc; programs written for this interpreter become extremely unwieldy and difficult to manage if they go beyond 64K. If a programmer wants to write a program larger than 64K, then Basic is probably the wrong language to program it in.

On the other hand, the language compilers available for the pc all have the ability to work with larger address spaces and are therefore more conducive to the development of large programs.

There are two basic variables—speed and simplicity—that affect the decision regarding what format to put a program in. Many programs can fit comfortably in 64K; for these there is no need to burden the processor with the additional overhead of manipulating a larger address space. There's also no need to burden the programmer of such programs with the extra complexity of using a twenty-bit address model.

Since there are therefore two types of programs—those that work within a single 64K segment and those that don't—it seems only fair that they be treated differently by the filing system (DOS). As we'll see, this is a technically complex subject, but the immediate consequences for the user are held to a minimum by DOS.

During the process of program development under one of the Microsoft language compilers or under the *Macro Assembler*, there is a stage called *linking*. This is the process by which different sections of a program may be combined to form a single unit. The result of this linking, a *run file*, is always stored by DOS with the extension .exe—for *executable*. This type of program will usually work with multiple memory segments.

The more popular .com files are reserved for programs that do not need to work with multiple segments.

As you might expect, there are major differences in the formats under which each of these two different file types are stored on disk. The manner in which information is written to and read from these two file types is the same, but there are significant differences in the linear disk structures of the two.

ASCII Text Files. Text files are the simplest of DOS files. The type of information they contain is rudimentary data, usually stored in a format compatible with a word processor or text editor. The minieditor Edlin, supplied on your DOS disk, could quite easily be used to create, examine, or modify a text file. Most text files are compatible with most word processors. This is so because the ASCII standard defines the significance of key combinations beyond the simple alphanumeric keys.

The functions required by word processors and printers alike, such as carriage return, line feed, and tab advance, are defined by ASCII in a universal manner. They're referred to as *control characters* and are accessed through keyboard by the combination of the control key and specific alphanumeric keys.

For example, the hexadecimal code OD, which is the same as decimal 13, represents a carriage return in ASCII. It's also used to represent the key code for control-M. If you hold down the control key and press *m* on the pc keyboard, you'll see that that combination has exactly the same effect as pressing the enter (or *return*) key.

If you hold down the control key and press *i*, you'll get the same result as if you pressed the tab key. Control-I is represented in ASCII as 09 hexadecimal (9 decimal), and is the same as the horizontal tab-advance code in ASCII. If you hit a control-I or press the tab key in a situation where tab stops have not been otherwise explicitly defined, the pc provides default tab stops every eight character positions (starting with the first stop at position 9).

Another major source of information stored in ASCII text files are the source codes for programs written in high-level languages. Although the Basic interpreter supplied in ROM with the pc uses a special compressed format for storing programs, it also provides the option of loading or storing files in ASCII format. This feature makes it easy for Basic program listings to be used in conjunction with generally available programming utilities, such as cross-reference generators or program generators. It also facilitates the transportation of programs between different kinds of computers.

Batch files also contain simple ASCII data. In fact, we saw an example of ASCII codes at work when we learned how to construct a batch file directly from the keyboard. As you may remember, we always terminate the input of data to a batch file by pressing the F6 key. This key, in DOS, puts a control-Z character into your file, and then DOS interprets that character as an end-of-file marker. Control-Z, in fact, is recognized by most ASCII word processors and editors as an end-of-file code.

ASCII Record Files. Another type of DOS file that usually stores information in ASCII format is a *record* file. This type of file is typically the output of a database management program of some type, such as an accounting application or a name and address file. It's differentiated from an ASCII text file in that its information is structured into discrete records, whereas text files usually contain unstructured information—such as letters or documents.

If you list an ASCII record file on-screen, by means of the *type* command, what you'll see will probably look like gibberish interspersed between recognizable English words and numbers. The gibberish will be coded markings used to separate or delimit individual data records.

.Com Files. .Com files are standard DOS external command files and contain nothing but raw machine-language instructions—a memory image of a command program. When you enter a name into the DOS command line interpreter, the first thing DOS does is look on the logged or specified drive to see if there is a .com file by that name. If there is, DOS loads the file and transfers control to its machine-language instructions.

The loading procedure for a .com file is quite simple. Single-segment programs are always stored in what is known as the *code segment* of memory. This is the area of memory managed through a special register known as the CS—code segment. To load and run this type of program, then, DOS simply builds the required code segment prefix; this sets up the CS register to handle the program once it is loaded. DOS then directly loads the .com file to the appropriate area of memory and passes control to it. At that point the program is loaded and running.

.Exe Files. .Exe files, as mentioned earlier, are the files used to store program data that has not been "fixed up" to handle the segmentation problems. These are typically programs that work with multiple memory segments and are consequently more difficult to load and run than are simple .com programs. DOS has to do some initial processing and shuffling when it loads an .exe file before it can pass control to the machine-language program contained in the file.

At the beginning of each .exe file there is a signature number that identifies the file type. Immediately after that, there comes a series of numbers known as a control header. This information tells DOS a number of things it needs to know in order to process the information in the file. These things include the number of bytes actually used in the last sector of the file and the number of 512-byte-long segments in the file. From this information DOS can quickly determine the actual length of the program contained in the file.

One of the major functions in loading and running an .exe file is the posting of various modules to their correct positions in memory and the setting up of appropriate registers. A relocation table is used to facilitate this process, and the number of entries contained in this relocation table is passed to DOS through the file's control header. Following this in the file are a number of largely technical descriptors that aid DOS in first loading the file, then directing it or relocating it to its correct memory location—or, depending on circum-

stances, to several locations.

During the load process, DOS reads portions of the .exe file into memory and uses them to determine what to do with other parts of the file. As complex as all this may seem, many of the details are handled transparently, by both the linker at link time and by DOS at load time, so that all the user has to do is give DOS the name of the file to be loaded and run; the operating system does the rest.

On the DOS master disk is a utility program that can be used to convert certain .exe files to the .com format. This process speeds up both the loading and the execution of programs. The loading is faster, since DOS doesn't have to analyze tables and dispatch or relocate program modules; the execution of the program is faster, because there is no need for the program to incur the overhead of working with multiple segments.

Of course, any program that's to be converted from .exe to .com format must first be convertible—that is, it must meet a few simple conditions. The most important consideration, obviously, is that the program must be able to fit into and work within a single 64K segment.

The utility used to convert .exe files to .com format is called Exe2bin.com. The *bin* part is short for binary, since a .com program is simply the binary image of a program as it would exist in memory.

The command format for using the Exe2bin utility is similar to that of other DOS commands. In general, it is

EXE2BIN filespec filespec

where the first *filespec* names the source file—the .exe file to be converted—and the second *filespec* names the output file, the new file to be created.

There are several other simple rules associated with this command. For example, since the source file must be in the .exe format, there is no need to enter a filename extension; it automatically defaults to .exe. The output filename extension also defaults—in this case to .bin. The .bin extension is assigned because there are some cases where DOS can convert the source file to the appropriate file format but the command processor won't be able to load and run the file as a .com file. Understanding why this is so requires a thorough comprehension of machine-level programming.

On some occasions when an .exe file is run through the Exe2bin utility, a very important register value (known as the code segment instruction pointer) will be missing. The utility will therefore need to prompt the user for a "fixup" value. This value is directly under the command processor. It would normally be loaded and run under the control of another program. This technique is used for applications such as program overlays.

In most cases, however, the Exe2bin utility provides a clean conversion. The prerequisite is that the code segment pointer and the instruction pointer are set so the program loads into the lowest portion of available memory. That means it must reside in the very first code segment, defined by 0000, and it must have a hexadecimal offset into this segment of 0100 (decimal 256). The very lowest 256 bytes of memory are unavailable; they're reserved for DOS.

When a file has been processed through the Exe2bin utility and meets these requirements, it can be converted into a simple .com file. This, of course, is accomplished by means of the DOS *rename* command.

If the Exe2bin utility discovers while performing a conversion that the source file has its code segment instruction pointer specified incorrectly or that the file requires more than a single memory segment, it prints the error message

File cannot be converted

and aborts the process.

The types of files we've discussed include only the structures that are standard under DOS. It is also possible for a programmer to design and implement unique file structures. There are few limitations. The advantage to staying with standard DOS file formats is that the files so created can be manipulated with standard DOS utilities and the data they contain can be shared or used by other programs running under DOS.

The most significant of the nonstandard DOS files are those that contain uncopyable programs. Some software manufacturers have come up with methods of modifying files so they cannot be copied by means of the standard DOS *copy* and *diskcopy* utilities. These measures are usually reserved for the type of program susceptible to software piracy.

Copy protection usually involves some sort of modification of the file so that it can be run under standard DOS but not copied. The methods of accomplishing this are usually proprietary to the software vendor, for obvious reasons, and are beyond the scope of this discussion. For the programmer wanting to have files protected by such methods, DOS does supply several variables that can be modified—such as the physical size of a disk sector. It should be kept in mind, however, that such techniques limit the usefulness of DOS to the user and should therefore be avoided unless they're absolutely necessary. ▲

CONTEST WINNERS

The winner of the I Predict Contest in the January issue is J.K. Weaver of Seattle, Washington. Congrats, J.K.! You were the only one to get any of the top five favorites in order, even if it was only the first four out of the five. It was that last choice, *PC Man*, that spoiled the pristine perfection of your educated guess.

As for the rest of you sports out there, good show! Most of you had at least three of the top choices in your predictions, and some even four, but it was the correct order that eluded you. *Flight Simulator* is the surprise of the readers' poll, judging from the predictions. Only a few of you even considered it a contender, although a lot of you wanted it if you won.

Although J.K. wins the big one-hundred-dollar prize, he missed out on the fifty-dollar percentage bonus. The actual percentage of votes that included *VisiCalc* was 48.8 percent. Predictions ranged wildly from 8 to 98 percent. Fifty percent was the closest guess, made by two people. The winner, according to the random-number generator (where all is fair), is Tim Wong of San Francisco, California. Honorable mention goes to Richard Beard of Fairborn, Ohio.

A look of extreme bafflement goes to both Kris Campbell of Decatur, Illinois and No Name of Missing Postmark, U.S.A., for both predicting number one would win by 100 percent. Back to school, both of you!

Tough luck goes to the enterprising David Larson of Longwood, Florida, who sent us (by certified mail, no less) a box of more than five hundred separate entries—none of which contained the magic word *Flight Simulator*. Ouch!

While we're passing out prizes, another one hundred dollars worth of electronic groceries goes to Bruce A. Smith of Barton, New York, who won the Sleuthing for Spirits contest that appeared in the October Infocom Exec. It was a toughie, Bruce and you got the most right. ▲

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RESULTS

WARE POLL

l average from the weighted vote count pro-
ıe strength of feeling for a given program by
rating would be above 7, which would indi-
s of the program placed it among an owner's
iis indicator points up three programs that
WordStar with an 8.61 rating, *Volkswriter* at 8.46, and *VisiCalc* at 8.20.

Programs that received a significant number of votes and had a high weighted average were *SuperCalc*, 7.92; *EasyWriter 1.1*, 7.82; *PFS:File*, 7.81; *Multiplan*, 7.76; and *Total Information Management III*, 7.73. Three programs received superlatives from a relatively few voters. They were *EZLabel+*, 9.57; *EZMemo+*, 9.14; and *Personal Editor*, 9.00. Lack of widespread distribution is apparently what forces these packages into the sleeper category.

A more general look at the information developed from the poll shows that 284 different titles were cited by pc owners as being among their favorites. The gamut ranged from arcade games to C compilers, from accounting package modules to programming utilities.

The total number of packages mentioned and the widespread applications addressed gives testimony to the flood of software into the pc marketplace and to the diversity of uses to which the computer is put.

Seventy-two titles received at least one first-place vote. Those programs are listed separately in what might serve as a shopping list. As with the master list, this itemization shows the depth of the IBM market, both in terms of software available and in terms of interest by owners.

Among the interesting results of the balloting:

VisiCalc was the number one spreadsheet, but *Multiplan* made the Top Thirty even though it was out for only a relatively short time before being withdrawn from the market by IBM. Some of the voters must have been Lotus beta-testers because *1-2-3* got some support and a first-place vote.

in sales, and the results of this poll indicate that users were highly satisfied with both programs. Other old standards also received high rankings: *SuperCalc* was fourth, *dBase II* was sixth, *Microsoft Adventure* was ninth, *Home Accountant Plus* nabbed twelfth, *Microsoft Decathlon* gained thirteenth, and *Zork I* was fifteenth.

Final positions in the standings are determined by weighting the ballots sent in by *Softalk* readers. Ten times as much weight is allocated to a first-place vote as to a tenth-place vote. The index numbers that appear in the accompanying Top Thirty list are ratios of the weighted totals. The index number 32.80 for *Zork I* indicates that its weighted vote was approximately twice that of *MailMerge*, which had an index number of 16.09.

In terms of the number of ballots on which a program was mentioned, *FriendlyWare PC Introductory Set* was actually fourth, *dBase II* fifth, and *SuperCalc* sixth. But the consistently high ranking of *SuperCalc* pushed it into fourth. A like anomaly occurred in the next tier of programs. *Microsoft Adventure* and *PC-Talk* got more total votes than *Volkswriter*, but *Volkswriter*'s consistently higher ranking on the votes it received pushed it to seventh.

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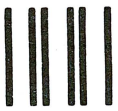
If the Exe2bin utility discovers while performing a conversion



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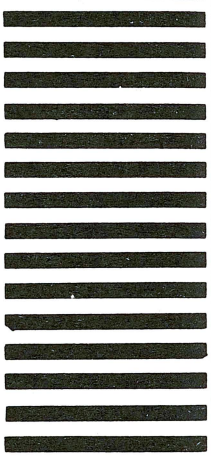

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CONTEST WINNERS

The winner of the I Predict Contest in the January issue is J.K. Weaver of Seattle, Washington. Congrats, J.K.! You were the only one to get any of the top five favorites in order, even if it was only the first four out of the five. It was that last choice, *PC Man*, that spoiled the pristine perfection of your educated guess.

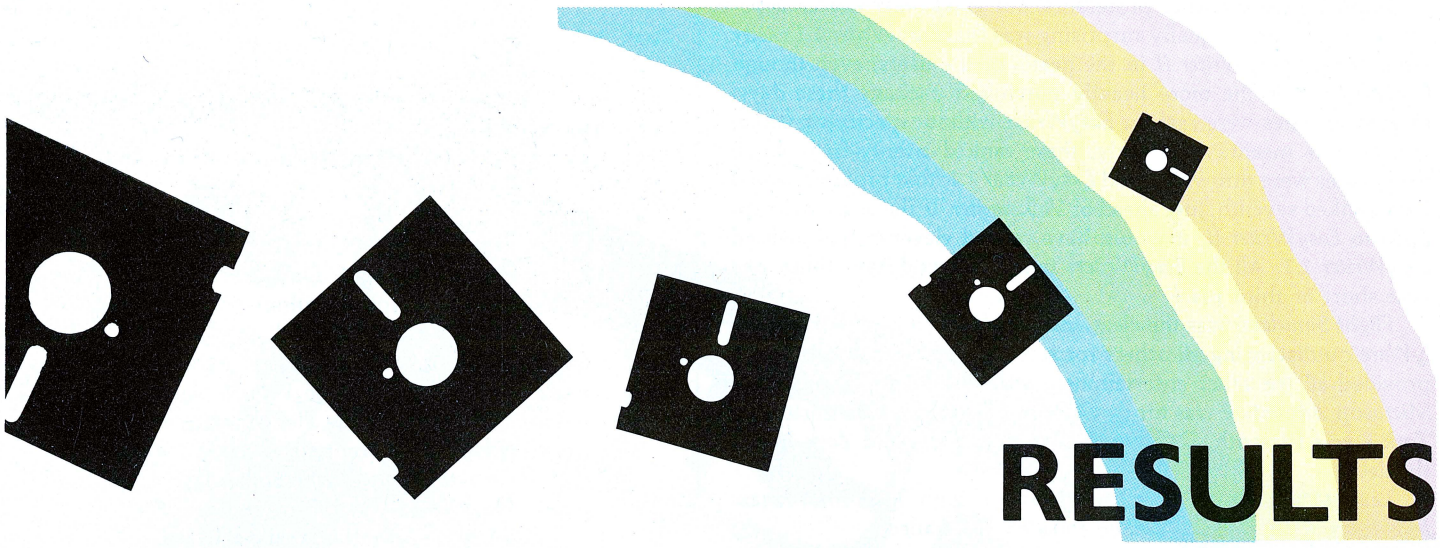
As for the rest of you sports out there, good show! Most of you had at least three of the top choices in your predictions, and some even four, but it was the correct order that eluded you. *Flight Simulator* is the surprise of the readers' poll, judging from the predictions. Only a few of you even considered it a contender, although a lot of you wanted it if you won.

Although J.K. wins the big one-hundred-dollar prize, he missed out on the fifty-dollar percentage bonus. The actual percentage of votes that included *VisiCalc* was 48.8 percent. Predictions ranged wildly from 8 to 98 percent. Fifty percent was the closest guess, made by two people. The winner, according to the random-number generator (where all is fair), is Tim Wong of San Francisco, California. Honorable mention goes to Richard Beard of Fairborn, Ohio.

A look of extreme bafflement goes to both Kris Campbell of Decatur, Illinois and No Name of Missing Postmark, U.S.A., for both predicting number one would win by 100 percent. Back to school, both of you!

Tough luck goes to the enterprising David Larson of Longwood, Florida, who sent us (by certified mail, no less) a box of more than five hundred separate entries—none of which contained the magic word *Flight Simulator*. Ouch!

While we're passing out prizes, another one hundred dollars worth of electronic groceries goes to Bruce A. Smith of Barton, New York, who won the Sleuthing for Spirits contest that appeared in the October Infocom Exec. It was a toughie, Bruce and you got the most right. ▲



RESULTS

THE MOST POPULAR SOFTWARE POLL

The grizzled veterans of the eight-bit world ran off with top honors in the first Most Popular Software Poll for the IBM Personal Computer. *VisiCalc* and *WordStar* dominated the voting, just as they dominate sales each month. Of these two, *VisiCalc* was the clear winner, getting fully 25 percent more votes than *WordStar*. *VisiCalc*'s runaway victory was achieved despite its absence from more than 50 percent of the ballots.

The new breed of sixteen-bit software attained a significant presence, however. The first ten positions were evenly split between pc-specific software and translated eight-bit software. Most dramatic development was the presence of brand-new *Multiplan* among the Top Thirty programs. Its rapid ascent serves notice that the old guard had better pay attention.

But 1982 was the year for the traditional giants. *VisiCalc* and *WordStar* were the year-long leaders in sales, and the results of this poll indicate that users were highly satisfied with both programs. Other old standards also received high rankings: *SuperCalc* was fourth, *dBase II* was sixth, *Microsoft Adventure* was ninth, *Home Accountant Plus* nabbed twelfth, *Microsoft Decathlon* gained thirteenth, and *Zork I* was fifteenth.

Final positions in the standings are determined by weighting the ballots sent in by *Softalk* readers. Ten times as much weight is allocated to a first-place vote as to a tenth-place vote. The index numbers that appear in the accompanying Top Thirty list are ratios of the weighted totals. The index number 32.80 for *Zork I* indicates that its weighted vote was approximately twice that of *MailMerge*, which had an index number of 16.09.

In terms of the number of ballots on which a program was mentioned, *FriendlyWare PC Introductory Set* was actually fourth, *dBase II* fifth, and *SuperCalc* sixth. But the consistently high ranking of *SuperCalc* pushed it into fourth. A like anomaly occurred in the next tier of programs. *Microsoft Adventure* and *PC-Talk* got more total votes than *Volkswriter*, but *Volkswriter*'s consistently higher ranking on the votes it received pushed it to seventh.

Deriving a weighted average from the weighted vote count provides an indication of the strength of feeling for a given program by the user base. A strong rating would be above 7, which would indicate that most mentions of the program placed it among an owner's top four programs. This indicator points up three programs that rate exceptionally high: *WordStar* with an 8.61 rating, *Volkswriter* at 8.46, and *VisiCalc* at 8.20.

Programs that received a significant number of votes and had a high weighted average were *SuperCalc*, 7.92; *EasyWriter 1.1*, 7.82; *PFS:File*, 7.81; *Multiplan*, 7.76; and *Total Information Management III*, 7.73. Three programs received superlatives from a relatively few voters. They were *EZLabel+*, 9.57; *EZMemo+*, 9.14; and *Personal Editor*, 9.00. Lack of widespread distribution is apparently what forces these packages into the sleeper category.

A more general look at the information developed from the poll shows that 284 different titles were cited by pc owners as being among their favorites. The gamut ranged from arcade games to C compilers, from accounting package modules to programming utilities.

The total number of packages mentioned and the widespread applications addressed gives testimony to the flood of software into the pc marketplace and to the diversity of uses to which the computer is put.

Seventy-two titles received at least one first-place vote. Those programs are listed separately in what might serve as a shopping list. As with the master list, this itemization shows the depth of the IBM market, both in terms of software available and in terms of interest by owners.

Among the interesting results of the balloting:

VisiCalc was the number one spreadsheet, but *Multiplan* made the Top Thirty even though it was out for only a relatively short time before being withdrawn from the market by IBM. Some of the voters must have been Lotus beta-testers because *1-2-3* got some support and a first-place vote.

WordStar led the word processors, but *Volkswriter* was an absolutely solid second. Equally surprising was that *EasyWriter 1.1* easily outdistanced *EasyWriter II* in the hearts of the users, even though *EasyWriter II* is the more heavily purchased package these days. Dozens of votes were cast for *EasyWriter* without specifying which version was meant. As a body, these ranked twenty-fifth. If all those votes were thrown behind *EasyWriter 1.1*, that program would have ranked seventh, just ahead of *Volkswriter*. If the votes were applied to *EasyWriter II*, it would have ranked eleventh, just behind *EasyWriter 1.1*. All the *EasyWriters* together would have fallen one vote short of third place.

Flight Simulator was the clear entertainment choice, with *FriendlyWare* outdistancing all others for second. Microsoft and Infocom provided all the other entertainment software in the Top Thirty: *Microsoft Adventure* was ninth, *Microsoft Decathlon* was thirteenth, *Zork I* was fifteenth, *Deadline* was twenty-third, and *Zork II* was thirtieth.

Leading database program was *dBase II* with *Total Information Management III* second. *VisiFile* and *PFS:File* trailed.

The eighth-ranked program in the hearts of pc users is *PC-Talk*, the communications package that represents a total break with traditional marketing techniques. Written and distributed by Andrew Fluegelman of *PC* and *PC World* fame, the program is given away with the caveat that if the recipient finds it useful, he may remit a voluntary sum to cover Fluegelman's costs. Judging from the high regard in which the program is held, Fluegelman should be a few hundred thousand dollars richer. What's more likely is that Fluegelman is rich in spirit and about even at the cash register. More than one comment read, "Thanks, Andy F."

Basic Compiler led all utility packages in the balloting, but a surprise second choice was *Norton Utilities* from Peter Norton. *Norton Utilities* has lacked the strong distribution channels IBM provided for *Basic Compiler*. But its consistently high ranking among those who voted for it placed it higher than many packages that had more total votes.

A category that missed the Top Thirty listing was accounting. Even though both the BPI and Peachtree general ledgers sell well each month, they weren't ranked high by users. *BPI General Accounting* placed thirty-first, well ahead of Peachtree's seventy-fourth rank.

Next month's Crosstalk will contain some of the comments made by voters. One merits mention here. A voter cast a third-place vote for *Castle Wolfenstein*, a product available only on the Atari and Apple computers. The petulant comment accompanying the ballot was, "*Wolfenstein* should be available on the pc."

Why not? Most of the quality software is migrating that direction. ▲

TOP THIRTY

Rank	Index	
1.	221.11	**VisiCalc,** Software Arts/Dan Bricklin and Robert Frankston; VisiCorp, IBM
2.	183.00	**WordStar;** MicroPro
3.	99.47	**Microsoft Flight Simulator,** Bruce Artwick; Microsoft
4.	92.56	**SuperCalc;** Sorcim
5.	92.30	**FriendlyWare PC Introductory Set,** Michael D. Yaw, James J. David, Frank Smith, Alan Vanchura, John Leatherwood, and Bruce W. Moore; FriendlySoft
6.	87.25	**dBase II,** Wayne Ratcliff; Ashton-Tate
7.	64.01	**Volkswriter,** Camilo Wilson; Lifetree
8.	63.48	**PC-Talk,** Andrew Fluegelman; FreeWare
9.	53.25	**Microsoft Adventure,** Gordon Letwin (Will Crowther and Don Woods); IBM (Microsoft)
10.	51.92	**EasyWriter 1.1,** John Draper; IBM (Information Unlimited Software)
11.	47.01	**Basic Compiler,** Microsoft; IBM
12.	45.15	**Home Accountant Plus,** Mike Farmer, Bob Schoenburg, Larry Grodin, and Steve Pollack; Continental Software
13.	39.57	**Microsoft Decathlon,** Microsoft/Tim Smith; IBM
14.	34.79	**Norton Utilities,** Peter Norton; Peter Norton
15.	32.80	**Zork I;** Infocom
16.	28.68	**DOS 1.1,** Microsoft; IBM
	28.68	**EasyWriter II,** Basic Software Group; Information Unlimited Software
18.	27.36	**Macro Assembler,** Microsoft; IBM
19.	26.96	**IBM Pascal,** Microsoft; IBM
20.	23.51	**Typing Tutor,** Michael Sierchio (Dick Ainsworth and Al Baker); IBM (Microsoft)
21.	22.58	**Total Information Management III;** Innovative Software
22.	21.65	**Multiplan,** Microsoft; IBM
23.	19.52	**Deadline;** Infocom
24.	18.86	**BasicA,** Microsoft; IBM
25.	18.72	**EasyWriter** (version unspecified)
26.	18.46	**Proofreader;** Aspen
27.	17.26	**Asynchronous Communications Support;** IBM
28.	16.87	**PCFile;** TexaSoft
29.	16.09	**MailMerge;** MicroPro
30.	15.40	**Zork II;** Infocom

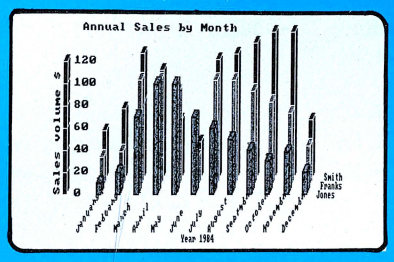
FIRST PLACERS

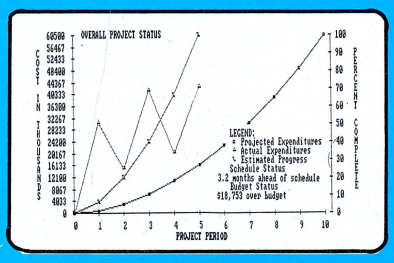
The following programs each received at least one first place nomination.

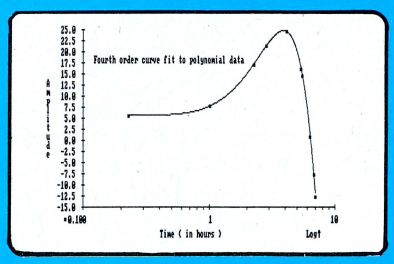
1-2-3
AST Superdive
Asynchronous Communications Support
Basic Compiler
BasicA
BPI General Accounting
Caprock C Compiler
C86 Compiler
Communicator/Text Editor
Computer Innovations C Compiler
Condor
Creator
Crosstalk
Dataease
dBase II
DOS & Basic Language Extension
DOS 1.1
EasyWriter
EasyWriter 1.1
EasyWriter II
Edix
EZLabel+
EZMemo+
Final Word
Financer
Forth Level II
Forthwrite
FriendlyWare P.C. Introductory Set
Home Accountant Plus
IBM Pascal
Instructor
JFormat
Keynote
Macro Assembler
MBA
Micro DSS/F
Micro Link II
Microsoft Decathlon
Microsoft Flight Simulator
Mince
MMS Forth
Multiplan
Norton Utilities
Oasis Multi-User
PCCrayon
PC-File
PC-Forth
PC-Help
PC/Personal Finance Program
PC-Talk
Personal Editor
PFS: File
PMate
Polycube
Pro Edit
Screen Design Facility
Snack Attack II
Speed Reader
Starcross
SuperCalc
System Backup
Text Editor
Total Information Management III
Typefaces
Ulysses and the Golden Fleece
VEdit
VisiCalc
VisiDex
Volkswriter
Wizardry
Word Perfect
WordStar

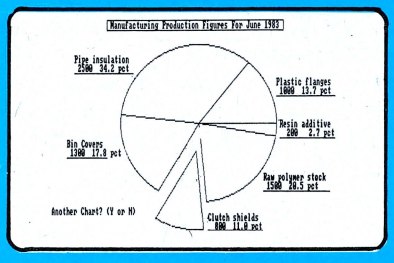
Omicron

OUR SOFTWARE SPEAKS FOR ITSELF









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QUESTIONS & ANSWERS

by Nancy Andrews

Q: I have the following questions about the IBM pc:

1. How may actual physical disk tracks and sectors, including the directory, be read?

2. How may an assembly language program be protected in memory so that other programs, such as utilities, *VisiCalc*, and *EasyWriter*, will not overwrite it?

3. How may an assembly language program be made part of DOS?

4. How may DOS be modified so that each DOS command entered may be intercepted and acted upon before DOS acts upon it, and how may DOS be modified so that the normal return to DOS may be intercepted and a user program in protected memory be executed?

Howard C. Best.

A: Here are some answers to get you started. Your first question, about reading physical disk tracks and sectors, will be covered by Alan Boyd in System Notebook—so watch his column.

Your second question, about putting a program in protected memory, is a difficult one. The pc doesn't have a memory management unit (it only has linear memory), so there's no standard way to do this. Our suggestion is that you contact the publishers of *VisiCalc* and *EasyWriter* and ask what address space they use. Then put your program in an unused portion of memory.

To make a program a part of DOS you have to give it a .com or .exe extension (specifications for .com programs are given in the DOS manual, page E-5). Then you can use the program as you would use any other external DOS command; or you can put it in an autoexec batch file so it runs automatically whenever you boot DOS.

As for your last question, to modify DOS in the way you describe requires customization of the file Command.com. Instructions for doing this are provided on pages B4 and B5 of the DOS manual. Be aware, however, that this is not an easy task. You should also realize that your customized Command.com may require recustomization if you get a new version of DOS.

Q: I spend a lot of time programming the pc, Apple, and Atari. About once a week either the computer or I will do something dumb and wipe out a program. The score is about ten system crashes on the Atari to three on the Apple to every one on the pc.

Here's how to hang up the pc and otherwise drive it crazy. First, *play* music that doesn't exist.

```
DIM MUSIC$ (10)
MUSIC$(1) = "CDE"      : REM plays normally
PLAY "XMUSIC$(1);"     : REM test - OK so far
PLAY "XMUSIC$(3);"     : REM doesn't exist
```

(Program gone and an error message appears)

More fun than hanging up on ghost music is *draw*ing strings that don't exist. These can reboot DOS, or fill the screen with random text, or do nothing, or wipe out the current program and hang up the pc. Here's how:

```
SCREEN 1
PIC$(1) = "U5R4"        :REM test a normal draw string
DRAW "XPIC$(1);"        :REM works correctly
DRAW "XPIC$(4);"        :REM doesn't exist yet
                ----- C R A S H -----
```

Mark Cross

A: We tried the programs as you suggested, and on our systems both programs crashed all the way to DOS. Then when we tried to reload Basic, the keyboard froze and the only way out was to turn off the system and start over. The reason we crashed instead of getting a simple error message is still a mystery, but the reason we could not successfully reenter Basic is that we didn't leave by the front door. Because we exited inappropriately, certain tables necessary to enable one to reenter were not updated.

Of course, this whole problem could be avoided if we all followed the standard programming practice of initializing our arrays at the beginning of each program. It wouldn't be nearly as interesting, but it might save time.

Q: I have a question that is related to information given by Alan Boyd in the January System Notebook. Mr. Boyd, in describing file names and how DOS searches the directory, states that "it reads each entry only up to the first space character. . . ."

It is true that when you name a DOS file "My File.bat," the directory returns the name "My." However, when Basic or BasicA is loaded and the same program is saved with *save* "My File.bat," the name and blank characters are saved. *Dir* will then read the name and blanks—which brings me to my question. How are these two operations similar? The function seems to be the same, but the methods used do not seem to be. Are they the same function or not? I have used blanks in my file names, but I usually am in Basic when I am doing it.

David C. Hohnadel

A: Both Basic and DOS have built-in functions to save files, but your hunch is correct; they are separate functions and operate differently with respect to file names. Basic's function works as you've described, allowing spaces in file names, whereas DOS's function eliminates those spaces when it saves a file name.

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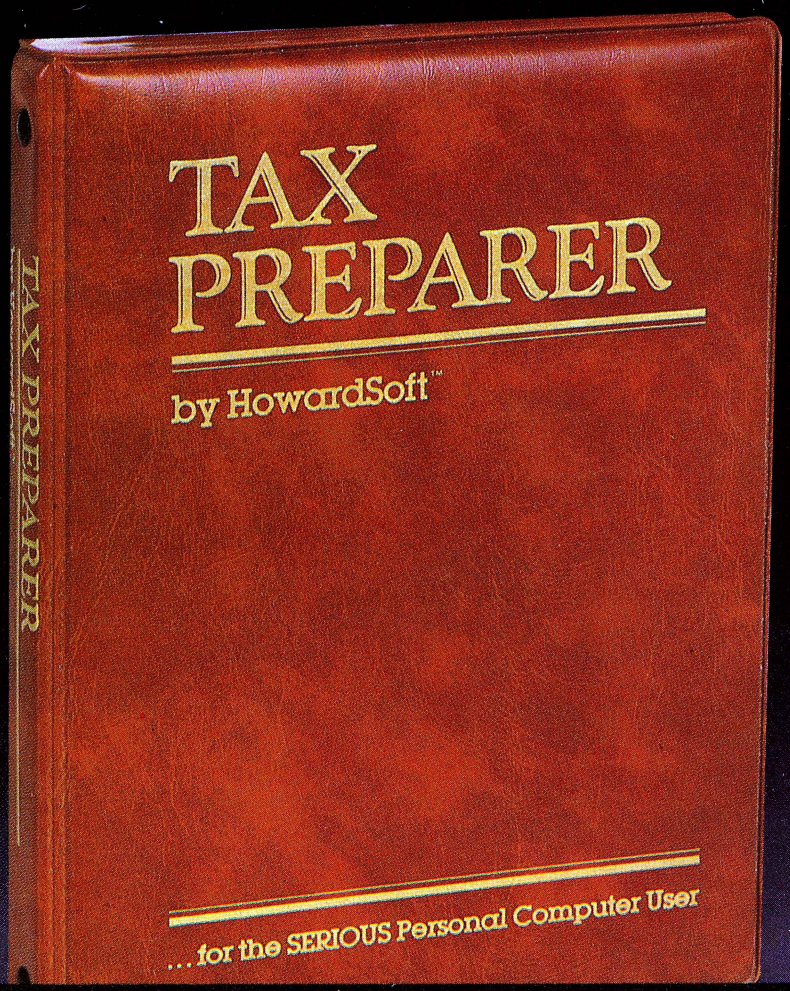

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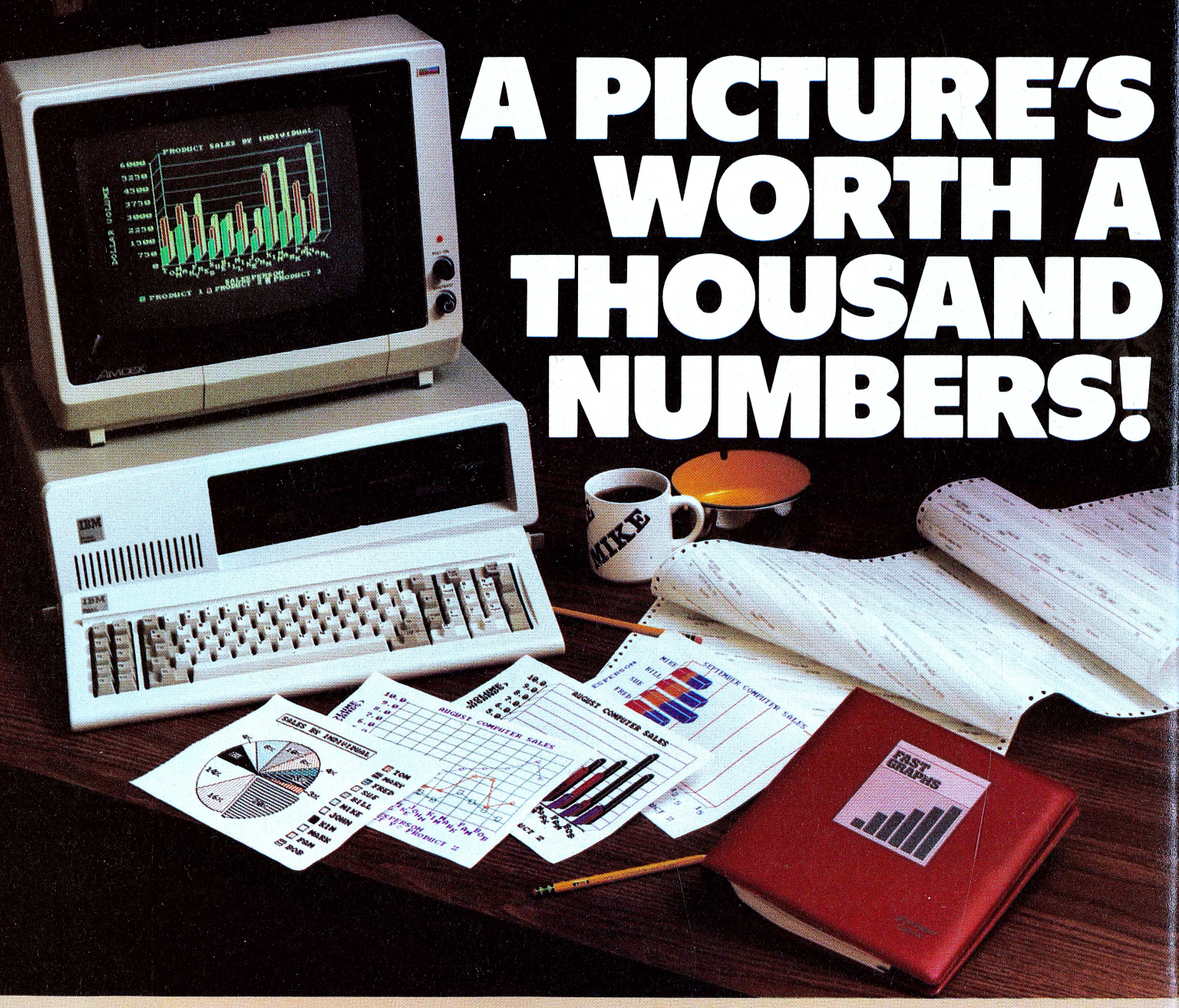

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Q: In statistical analysis of data using my IBM pc, I found it impossible to transfer files between DOS and UCSD p-System. I have noted that one company advertises that its version of the UCSD p-System produces DOS-compatible files. Is there any available software for transferring UCSD p-System and DOS data files?

Nancy Andes

A: Softech Microsystems, manufacturer of the UCSD p-System, is creating software to transfer files between DOS and the p-System. Its product will be called *Xenofile*, and the company predicts it will be available by late spring or early summer. It will work somewhat like the p-System filer; you'll describe one file as a p-System file and one as a DOS file and then will be able to transfer data between them.

Q: In the October Boards and Buses Richard Kaapke says it is possible to put eight-inch drives on the pc. My need is to read eight-inch IBM 3740 format ASCII files. Can this be done in a low-cost way using the IBM disk controller? I have called all over the United States and so far located only Flagstaff Engineering's product, which is complete and, I'm sure, effective but too expensive for my personal budget. Thanks for any information you can offer.

Michael Barta

A: As far as we know, there is no way to do this. Sorry for the bad news. If any readers know of a way to do this, please let us know.

Q: I recently added Graftrax-Plus PROMs to my Epson MX-80 F/T printer, and I'm having trouble with some of the printer commands while operating under DOS. The troublesome commands are some of the new ones, like superscripting.

To adapt the Basic printer commands to DOS I use the Alt key to input the ASCII characters, shifting, if necessary, the character code by +128 to get the desired action. Thus the italic character set is turned on with Alt-1554. One controls the underline mode in Basic with *chr$*(27)''−''*chr$*(n), with n=1 turning on underlining and n=0 turning it off. However, in DOS Alt−155 − Alt=n gives the *on* action for any value of n, including 128. Also, the "W" double width mode works fine in Basic but doesn't work in DOS.

An explanation for what is causing this problem would be interesting even if there is no simple fix. The fact that Alt−0 is not the equivalent of *chr$*(0) may be involved.

Andrew G. Fabula

A: You seem to have pinpointed the problem. It revolves around the fact that Basic only reads the low-order byte and DOS reads both the high and low bytes; something then gets skewed as these commands are sent to the printer.

Here is a way to see what is actually happening:

1. Create your file
2. Go into the Debug program
3. Load your file into Debug's memory
4. Browse through your file using the *dump* statement

This will enable you to see exactly what is being sent to the printer and then to change your file so the printer actually gets what you intend. Let us know what you discover!

Q: I'm using the Communications program on the DOS disk to send files to a mainframe. To stop transmission I have been using control-Break, but since this is a Basic program it goes beyond stopping transmission and sends me out of the program as well. Is there a way to send a break other than control-Break?

Alex Weiss

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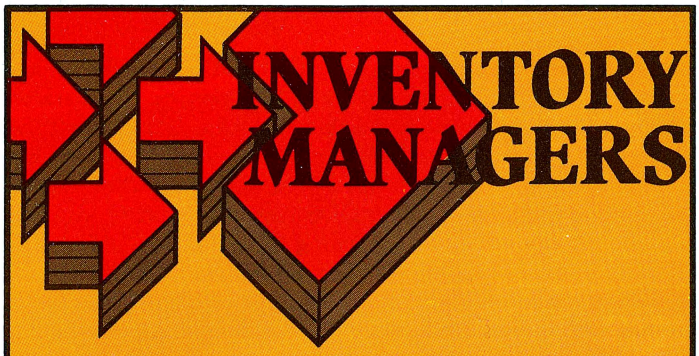

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A: What you want to send to stop transmission is the XOFF character, control-S. Then, to resume, send XON, control-Q. This should work without terminating the communications program.

Q: I'm interested in linking IBM Basic graphics procedures to IBM Pascal. Do you have information on how to do this?

Mark Bridges

A: As far as we know, you cannot link IBM Basic and IBM Pascal. Your best bet for graphics would be to write the graphics with the *Macro Assembler.* Then you can use the DOS Link program to link the object files produced by the assembler and the object files produced by the Pascal compiler. Unfortunately, the binary files produced by the Basic compiler are not linkable.

Q: My *WordStar* is developing a problem that peeves me greatly. Adding insult to injury is the fact that Computerland is unable to come up with a solution and MicroPro arrogantly refuses to talk to any end user.

The space bar, even if depressed ever so shortly, is producing two spaces instead of one in about 5 percent of all cases, fully at random and without any pattern, except that it never occurs at the beginning of a line. This happens regardless of whether the file is to be saved on the program or the data disk.

This is very disturbing to someone who does not constantly look at the screen but types away, trusting the program to do what it is supposed to do. Going over the written text later on and correcting each failure is very bothersome and extremely time-consuming—in other words, a pain.

I've tried everything—a new copy, new disks, cleaning the drive—all to no avail. And since *WordStar* performed reliably in this regard for quite a while, I wonder what the cause of this sudden deterioration is and what can be done to remedy the situation. Can you help?

H. D. Laun

A: Since you've tried all the reasonable software corrections, our hypothesis is that you have a hardware problem. To test this hypothesis, you might try your program with a different keyboard or on your dealer's pc. If *WordStar* doesn't malfunction with a different keyboard, you'll need to have your keyboard's space key checked. If you're handy, disassemble it yourself, but be careful—it's spring-loaded. Then you can clean it, check the pad under the space key to be sure it's not cracked or broken, and reassemble it. When you reassemble, it's best to have two people—one to hold and the other to replace the screws. Good luck!

Q: Is there any software that makes it possible for the IBM to read disks written in a format other than IBM format? In particular, is there a utility that can read a file from an Apple or TRS-80 disk in one drive and store the file on an IBM disk in another drive? This would be very useful.

Robert A. Wolfe

A: Currently, you can read and convert Apple files, but not quite as simply as you'd like. There is a package called *The IBM-Apple Connection* by Alpha Software that facilitates this. However, your IBM must be directly connected to the Apple with a crossover cable or you must connect by telephone and modem. In addition, your IBM must have an RS-232 port and your Apple must have either a Micromodem II or a Mountain Hardware CPS card.

Alpha does not have this utility for the TRS-80 but plans to develop it in the future. ▲

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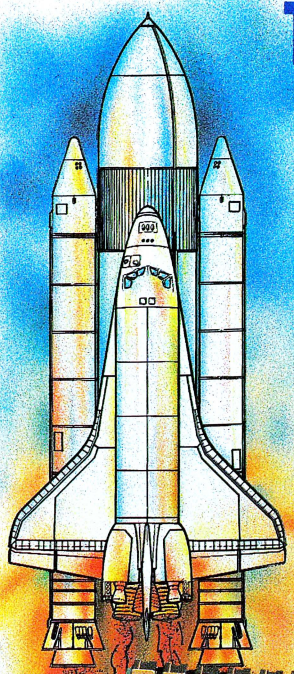

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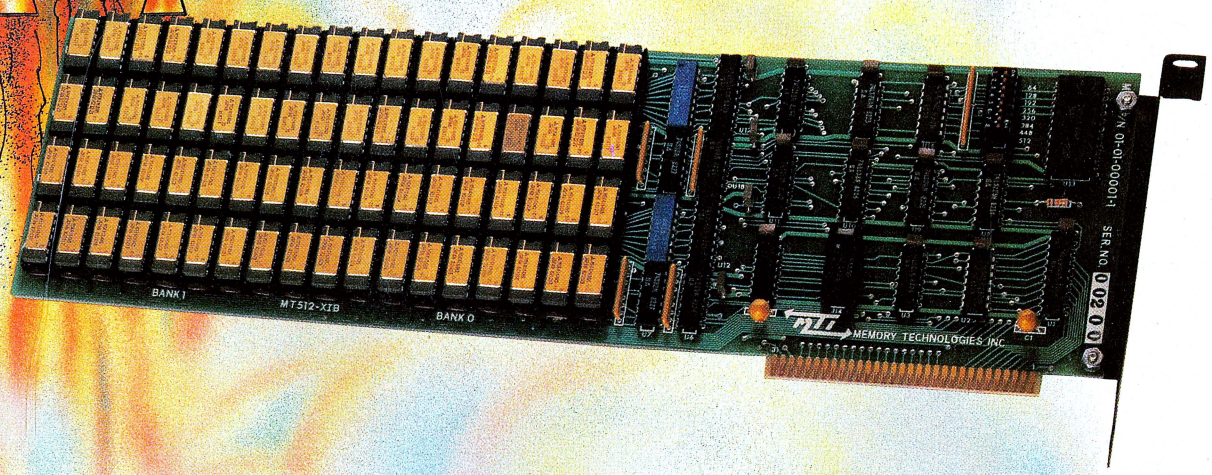

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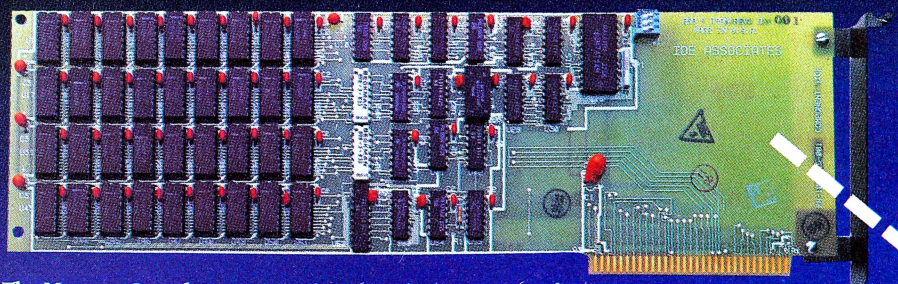

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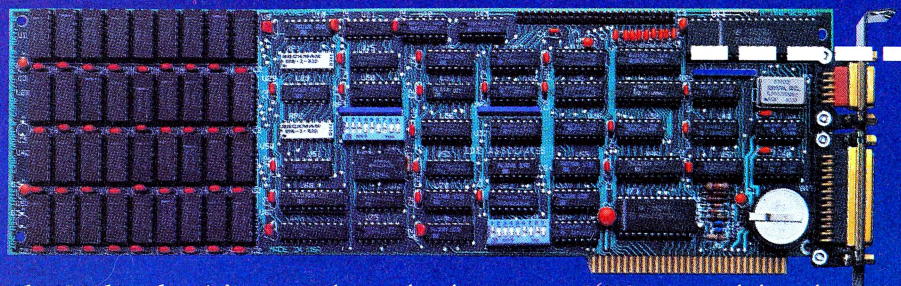
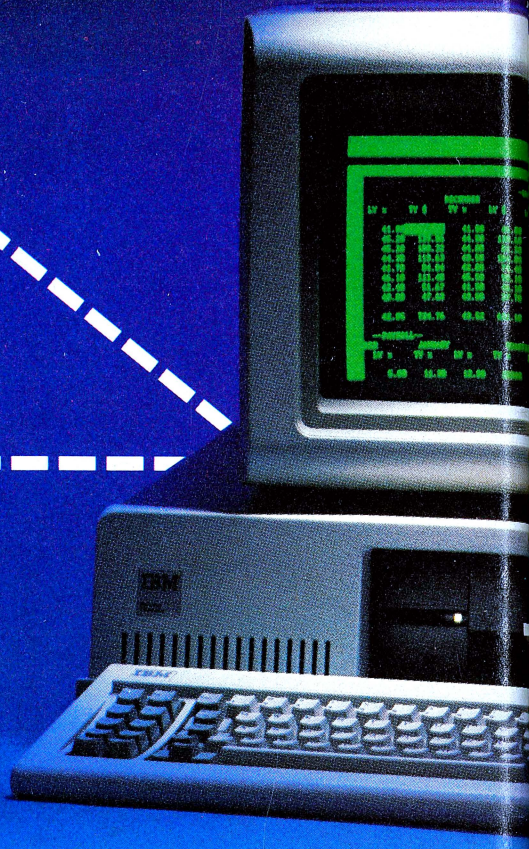


The IDEAboard: Multifunction combination board. Memory up to 265KB. Options include serial interface, parallel interface (printer or SASI hard disk) and/or clock/calendar with battery backup. Prices range from $350 for 64KB with 1 option to $725 for 256KB with 3 options.



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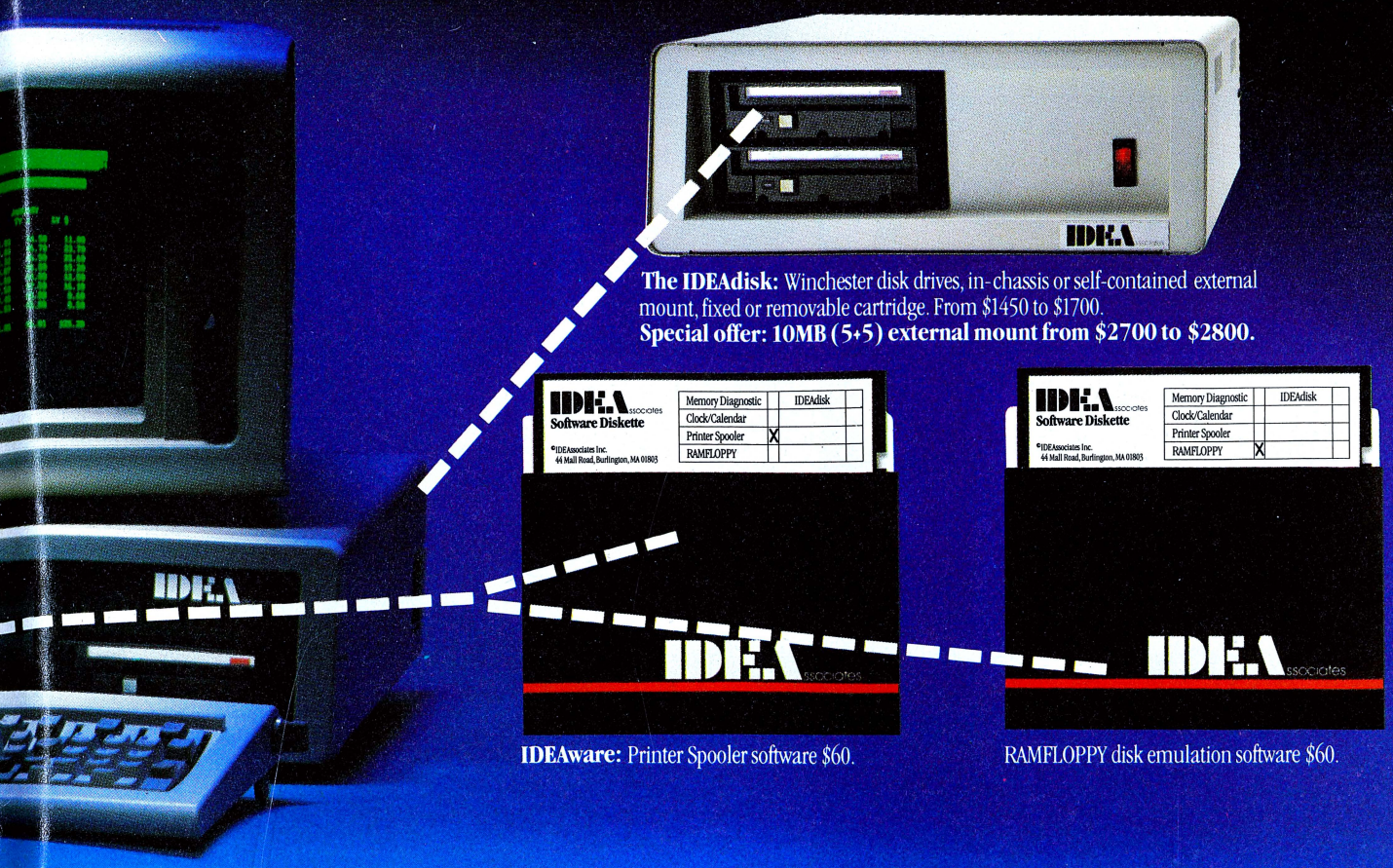

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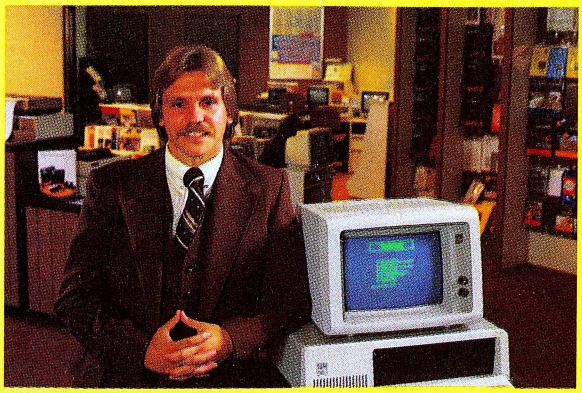

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softalk presents the bestsellers

It is entirely possible that we'll all look back on the January 1983 IBM marketplace as the watershed for what's to follow. Even if that's not true, January sales have set up a real melodrama, with a cliffhanger scheduled every month.

The arrival of *1-2-3* and the arrival and departure of *Multiplan* heat the spreadsheat rivalry to white hot intensity.

WordStar clings to a seemingly commanding lead among word processors, but *Volkswriter* and both *EasyWriters* are gaining.

Infant companies with exciting products are finding the means to make an impact.

And all this is occurring in an environment of relatively slack sales.

January software sales were definitely on the disappointing side. The first month of the year is usually one of the biggest, as Christmas buyers enter the aftermarket to stock up on more peripherals and software. Some of that occurred, but not nearly as much as would be indicated by the number of pcs sold in December.

However, lackluster sales can't dim the excitement being generated by some of the new and rebounding software. Eight new programs made the Top Thirty and each plays a role setting up this year's marketplace brouhaha.

The one program that regained the list was *EasyWriter 1.1*. For the past few months, the original *EasyWriter* was showing strength only in IBM Product Centers. But it broke out into other outlets in January, and the impact was on *WordStar*. *WordStar* actually improved its overall market position, but it lost ground to all three of its leading rivals in the word processor area. *EasyWriter II* moved up to fourth and *Volkswriter* was seventeeth. *WordStar*'s advantage over *EasyWriter II* is now barely two-to-one. That seems substantial until you recognize that last month it was more like ten-to-one.

The advent of *Multiplan* and *1-2-3* into the top ten had an immediate and deleterious effect on the perennial spreadsheet leaders, *VisiCalc* and *SuperCalc*. How it was accomplished in each case was also interesting.

Multiplan never got a full roll out into all the computer stores before IBM pulled it from the market. By early February, those stores that had received initial orders were sold out and unable to get more. Essentially, *Multiplan* scored while being in only about one-half the marketplace during January.

The ninth-place showing of *1-2-3* is even more dramatic. The program was in less than half the stores, and for only four selling days in January.

VisiCalc sales were impacted the most. For the first time since the introduction of the pc, the granddaddy of all spreadsheets dropped lower than second in overall sales. Third isn't bad, but it's not the kind of treatment VisiCorp expects for its bellwether program.

SuperCalc was barely affected by the new introductions. Most surprising of all was that *MBA* was not affected at all. Experts predicted that *1-2-3* would put *MBA* to rest, but that certainly hasn't been the case yet. *MBA* may eventually suffer in the market, but it was a steady performer in January.

Four of the new entries to the Top Thirty show that smaller companies can compete effectively with the likes of VisiCorp, Microsoft, MicroPro, Sorcim, and Infocom. Orion and FriendlySoft had already demonstrated that, but the addition of four more relatively small contenders can lend heart to the lone programmer hoping to strike a responsive chord among pc owners.

Highest rated of these four newcomers was *Norton Utilities* from Peter Norton. It tied with *Zork II* for nineteenth and represents the first time a utility package other than the ones from IBM scored big

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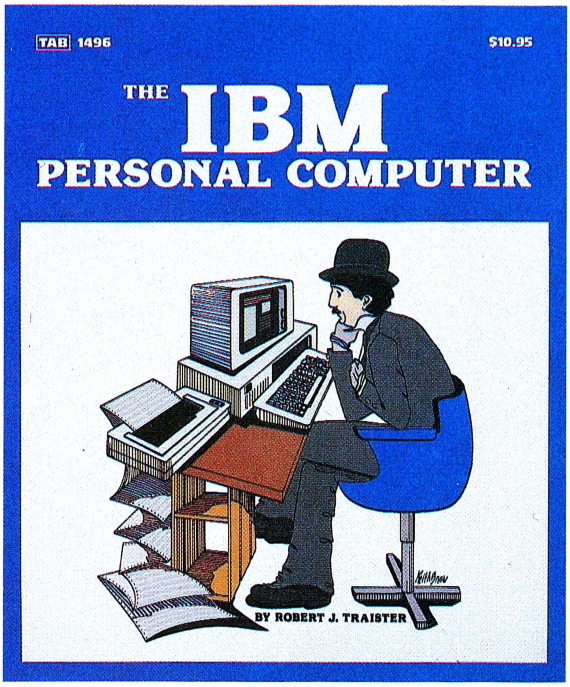
by Robert J. Traister



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in retail sales. It's a sign of marketplace maturity when user-oriented, as opposed to programmer-oriented, utilities start finding a place.

Entering the list at twenty-fifth was *VersaForm*, from Applied Software Technology. Although the company would dispute the label of a one-product firm, that's still what they are. That they've been able to establish a high-quality business program in the face of the big, multiproduct contenders augurs well for serious applications programmers everywhere.

Tied for twenty-seventh were two games—*Snack Attack II* from Funtastic and *Executive Suite* from Armonk. That the former is an arcade game while the latter is a strategy game shows that the entertainment market is broadening to make room for more than one or two superlative action games and the genre of text adventures.

Finally, *Adventures in Serenia*, IBM's adaptation of Sierra On-Line's successful *The Wizard and the Princess*, shows that there's also room for hi-res adventures.

If the January results are an indication, it'll be an interesting year: Hope for the small companies and contention among the big ones. ▲

IBM Personal Computer sales outlets representing approximately 4.2 percent of all sales of pc and pc-related products volunteered to participate in the poll.

Respondents were contacted early in February to ascertain their sales for the month of January.

The only criterion for inclusion on the list was the number of units sold—such other criteria as quality of product, profitability to the computer store, and personal preference of the individual respondents were not considered.

Respondents in February represented every geographical area of the continental United States.

Results of the responses were tabulated using a formula that resulted in the index number to the left of the program name in the Top Thirty listing. The index number is an arbitrary measure of relative strength of the programs listed. Index numbers are correlative only for the month in which they are printed; readers cannot assume that an index rating of 50 in one month represents equivalent sales to an index number of 50 in another month.

Probability of statistical error is plus or minus 5.3 percent, which translates roughly into the theoretically possibility of a change of 5.62 points, plus or minus, in any index number.

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the top thirty

This Month	Last Month	Index	
1.	1.	135.36	**WordStar;** MicroPro
2.	3.	98.45	**Microsoft Flight Simulator,** Bruce Artwick; Microsoft
3.	2.	79.99	**VisiCalc,** Software Arts/Dan Bricklin and Robert Frankston; VisiCorp, IBM
4.	8.	60.65	**Easy Writer II,** Basic Software Group; Information Unlimited Software
5.	4.	59.77	SuperCalc; Sorcim
	5.	59.77	**PC Man,** Greg Kuperberg; Orion
	6.	59.77	**Home Accountant Plus,** Mike Farmer, Bob Schoenburg, Larry Grodin, and Steve Pollack; Continental Software
8.	—	57.13	**Multiplan,** Microsoft; IBM
9.	—	53.62	**1-2-3,** Mitch Kapor; Lotus Development
10.	11.	46.59	**FriendlyWare PC Introductory Set,** Michael D. Yaw, James J. Davis, Frank Smith, Alan Vanchura, John Leatherwood, and Bruce W. Moore; Friendly Soft
11.	6.	43.95	**dBase II,** Wayne Ratcliff; Ashton-Tate
12.	—	31.64	**EasyWriter 1.1,** John Draper; IBM (Information Unlimited Software)
13.	9.	29.01	**Zork I;** Infocom
14.	19.	27.25	**Deadline;** Infocom
15.	14.	22.85	**Asynchronous Communications Support 2.0;** IBM
16.	10.	21.97	**Microsoft Decathlon,** Microsoft/Tim Smith; IBM
17.	18.	21.10	**Volkswriter,** Camilo Wilson; Lifetree
	30.	21.10	**Typing Tutor,** Michael Sierchio (Dick Ainsworth and Al Baker); IBM (Microsoft)
19.	12.	19.34	**Zork II;** Infocom
	—	19.34	**Norton Utilities,** Peter Norton; Peter Norton Inc.
21.	19.	17.58	**General Accounting,** John Moss and Ken Debower; IBM (BPI)
22.	30.	15.82	**Temple of Apshai,** Jeff Johnson, John Freeman, and J. W. Connelly; Epyx/Automated Simulations
23.	14.	14.94	**Crosstalk;** Microstuf
	19.	14.94	**MBA;** Context Management Systems
25.	—	14.06	**Versa Form,** Joseph Landau; Applied Software Technology
26.	23.	13.18	**Microsoft Adventure,** Gordon Letwin (Will Crowther and Don Woods); IBM (Microsoft)
27.	—	12.31	**Snack Attack II,** Dan Illowsky; Funtastic
	—	12.31	**Executive Suite;** Armonk
29.	13.	11.43	**Total Information Management III;** Innovative Software
	17.	11.43	**VisiFile,** Creative Computer Applications/Colin Jameson and Ben Herman; VisiCorp
	—	11.43	**Adventures in Serenia,** Ken and Roberta Williams; IBM (Sierra On-Line)

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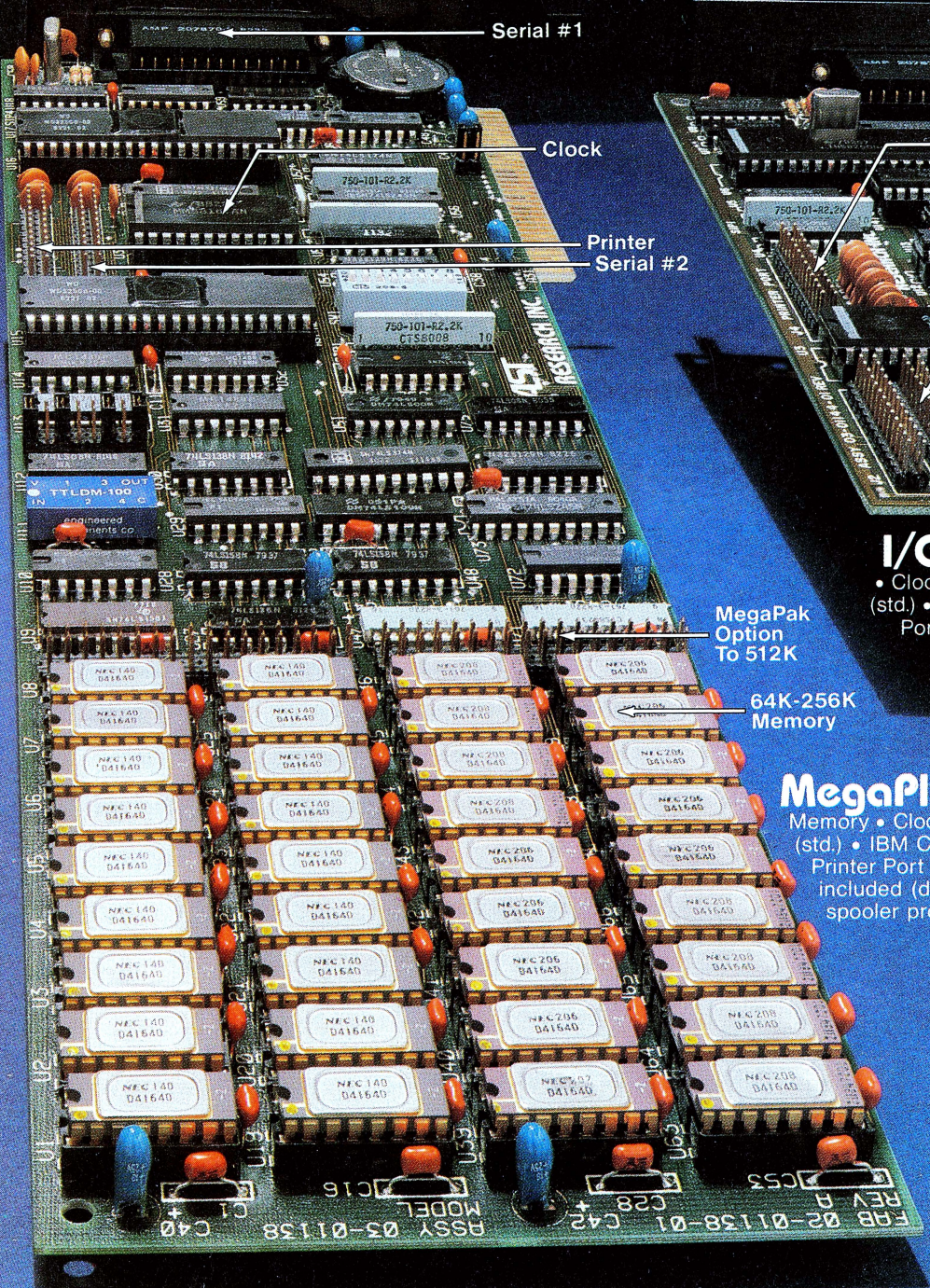

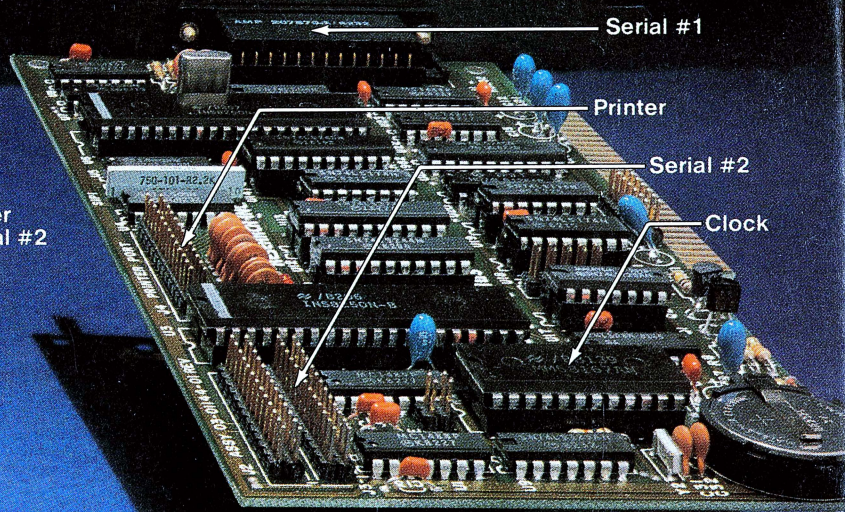

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